

State of California  
The Resources Agency

DEPARTMENT OF WATER RESOURCES  
Division of Operations and Maintenance

# **STATE WATER PROJECT ANNUAL REPORT OF OPERATIONS 1998**

**November 2003**

**Gray Davis**  
Governor  
State of California

**Mary D. Nichols**  
Secretary for Resources  
The Resources Agency

**Thomas M. Hannigan**  
Director  
Department of Water Resources

This Annual Report of Operations for the State Water Project has been published since 1974. The SWP Annual Reports have been made available on the World Wide Web at <http://www.woco.water.ca.gov>. It provides the State Water Service Contractors, public agencies, consultants, and others with the daily and monthly status of the Project's water and power operations.

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## Foreword

This is the twenty-fourth in a series of annual reports summarizing the water and energy operation of the California State Water Project. Although the reports in this series are published considerably after the reference year, they document the official record of operations and provide an important source of historical data. This report summarizes the operation of Project facilities during 1997 and includes any revisions to data previously published in the more timely monthly "State Water Project, Operations Data" reports.

Chief  
Division of Operations and Maintenance



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## Conversion Factors

Quantity	Multiply	By	To obtain
<b>Area</b>	acre	43,560	square feet
<b>Volume</b>	cubic foot	7.481	gallons
	cubic foot	62.4	pounds of water
	gallon	0.13368	cubic feet
	acre-foot	325,900	gallons
	acre-foot	43,560	cubic feet
	million gallons	3.07	acre-feet
<b>Flow</b>	cubic foot/second (cfs)	450	gallons/minute (gpm)
	gallons/minute	0.002228	cubic feet/second (cfs)
	million gallons/day	1.5472	cubic feet/second (cfs)
	cubic foot/second (cfs)	646,320	gallons a day
	cubic foot/second (cfs)	1.98	acre-feet a day
	million gallons/day (mgd)	1,120	acre-feet a year
<b>Pressure</b>	feet head of water	.433	pounds/square inch (psi)
<b>Power</b>	kilowatts (kW)	1.3405	horsepower (hp)

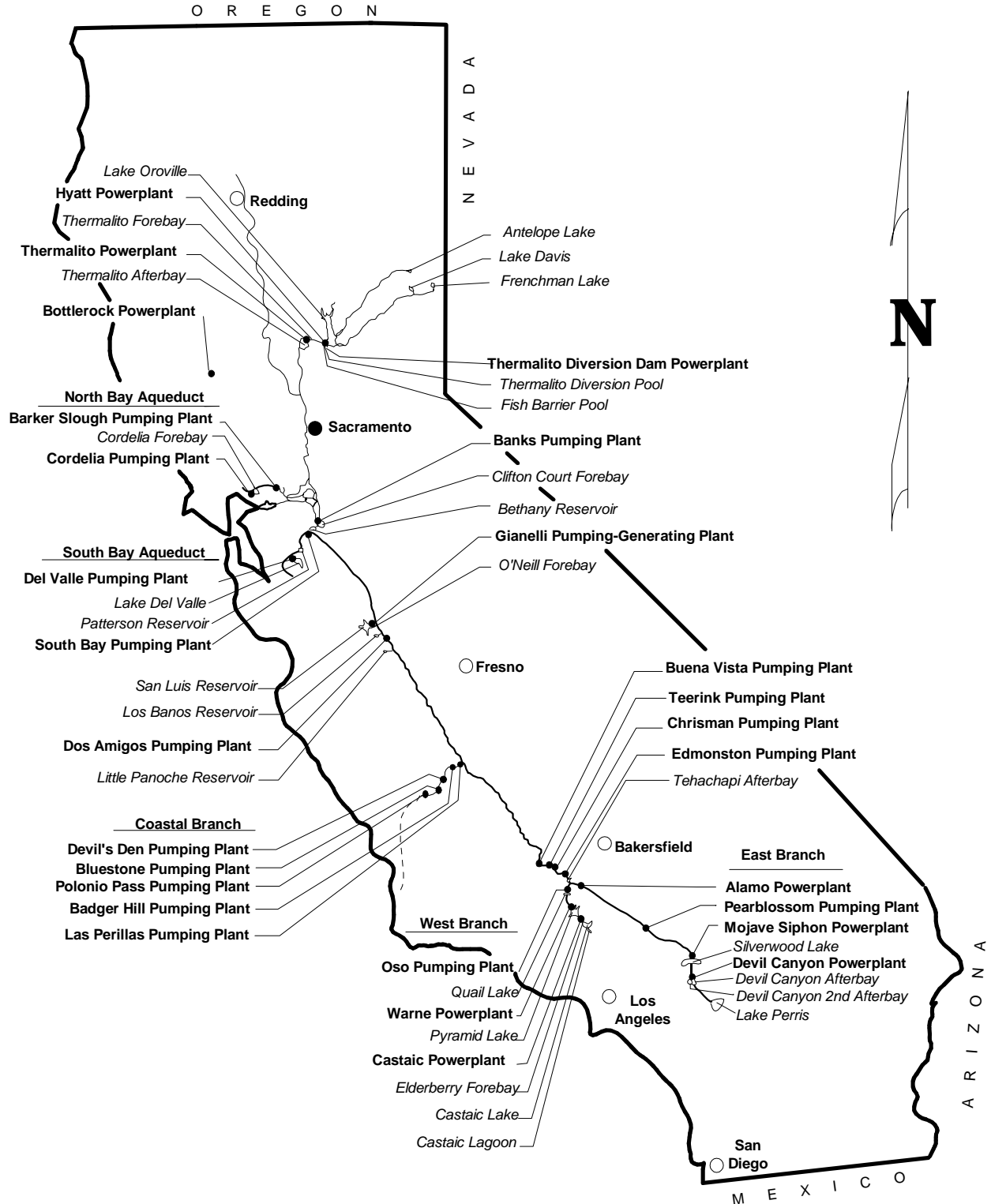
## Abbreviations and Units

The following abbreviations are commonly used throughout this report.

AF	acre-feet
Banks	Harvey O. Banks Delta Pumping Plant
California Aqueduct	Governor Edmund G. Brown California Aqueduct
CEA	Capacity Exchange Agreement
cfs	cubic feet per second
CVP	Central Valley Project
D-1485	Water Rights Decision 1485
DFG	Department of Fish and Game
DO	dissolved oxygen
DOI	Delta Outflow Index
DPR	Department of Parks and Recreation
DWR	Department of Water Resources
EC	electrical conductivity
FRSA	Feather River Service Area
ft	feet
KCWA	Kern County Water Agency
kv	kilovolt
kW	kilowatt
kWh	kilowatt-hour
LADWP	Los Angeles Department of Water and Power
MAF	million acre-feet
MW	megawatt
MWh	megawatthour
MWDSC	Metropolitan Water District of Southern California
NDOI	Net Delta Outflow Index
PG&E	Pacific Gas and Electric Company
SCE	Southern California Edison
SDWA	South Delta Water Agency
SRI	Sacramento River Index
SWP	State Water Project
SWRCB	State Water Resources Control Board
USBR	United States Bureau of Reclamation

# Map 1

## Project Facilities



## *Introduction*

The 1998 Annual Report of Operations for the State Water Project is divided into seven parts. The first two parts, "Highlights of 1998 Operation" and "Project Status in 1998," cover conditions and events of statewide significance. The following three parts cover water conditions, water operations, and energy operations in 1998. The sixth part, "Sacramento-San Joaquin Delta Operations," gives special emphasis to Delta operations, a key aspect of the SWP. The last part, "Project Operations by Field Division," provides details on activities by field division as outlined on Map 2.

## *Highlights of 1998 Operation*

Managing available water supplies during the 1987-1992 drought required activities designed to make the most beneficial use of water available to the SWP. The Department of Water Resources initially structured its plan of operations according to the concept of a firm yield. Firm yield is the quantity of water that can be made available on a firm annual basis to water contractors during a drought period. In 1991, after years of discussion, DWR changed its method of determining delivery amounts and replaced the concept of firm yield with the concept of variable yield. Operating on the basis of a variable yield makes efficient use of available water supplies during a drought. DWR also developed programs to compensate for the lack of storage facilities. These programs include water transfers, exchanges, loans, storage, purchases, and carry-over entitlement for delivery at a later date.

Total original requests for entitlement water were about 3.34 MAF. The initial allocation in December 1997 provided for 70 percent of Table A entitlements or 2.41 MAF. On February 11, 1998, due to increased supplies, DWR approved 80 percent of Table A or initial request, whichever is less. DWR made the final allocation of 2.95 MAF.

Runoff in water year 1998 in the Central Valley rivers was about 20 percent more than in 1997. Total runoff for the eight major rivers of the Sacramento-San Joaquin River system was nearly 42 MAF, about 175 percent of average and the sixth wettest of record.

Water year 1997-1998 was the fourth wet year in a row. A strong El Nino affected the year in the eastern tropical Pacific Ocean that produced above-average precipitation in California.

In contrast to 1997, coastal watersheds and smaller basins generated the larger floods of 1998. The upper Sacramento Valley was also wet; flooding was comparable to the larger floods of record.

October started the water year with near-normal precipitation while November was above average. December was below average. Both January and February were extremely wet.

March and April had above-average precipitation, but were not nearly as wet as February. May was cool and wet. A surprise storm in the upper Sacramento Valley near the end of May produced moderate flood flows in the Sacramento River. June started out cool and wet, but in the middle of the month the weather turned dry and remained that way for the rest of the summer. September saw near-normal showers in the mountains.

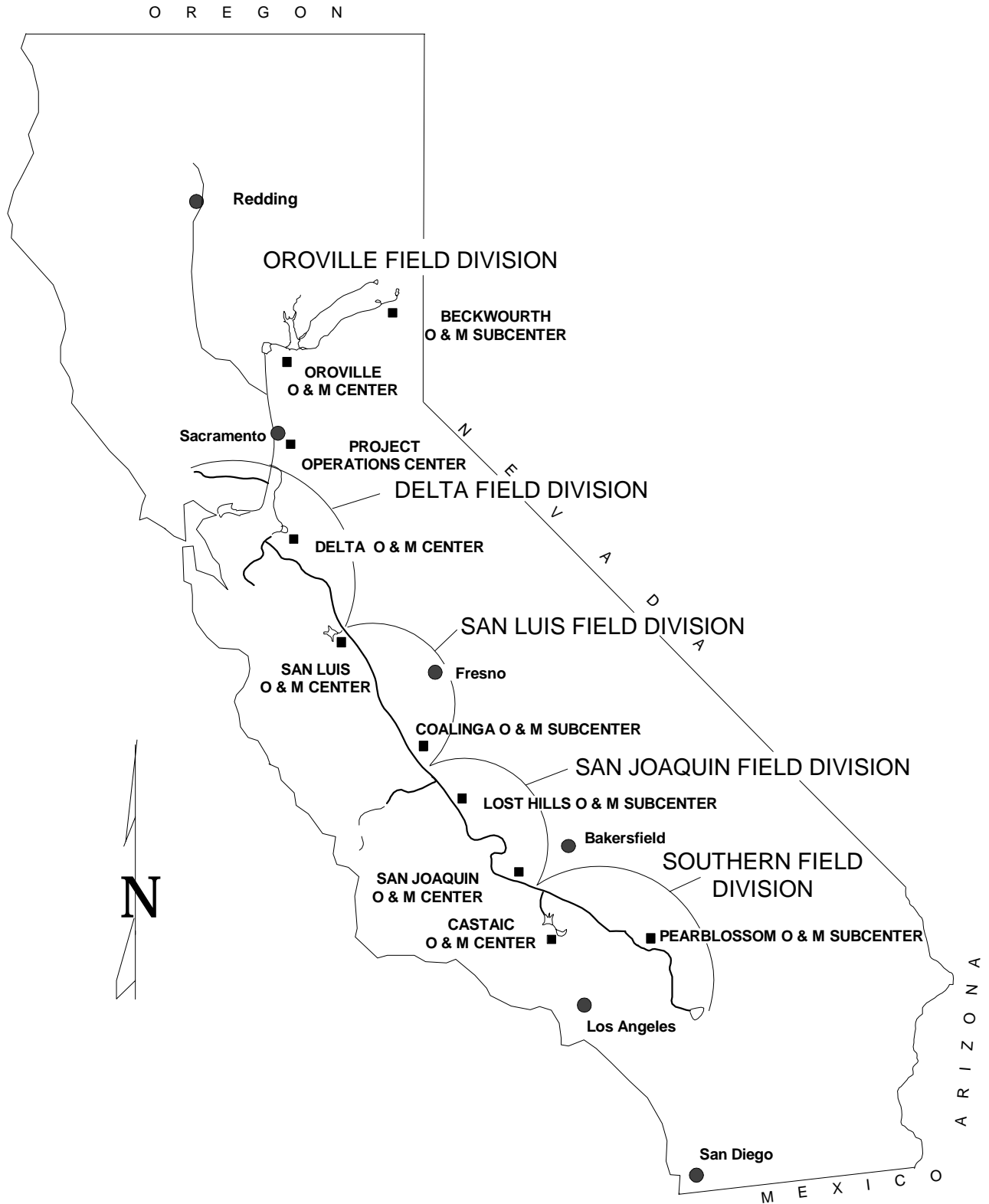
DWR and USBR did not declare balanced Delta water conditions during 1998.

The SWP depends on a complex system of dams, reservoirs, power plants, pumping plants, canals, and aqueducts to deliver water. Although initial transportation facilities were essentially completed in 1973, other facilities have been constructed since then and still others are under construction or are scheduled to be built as needed. The SWP facilities now comprise 27 dams and reservoirs, 25 pumping and generating plants, and nearly 600 miles of aqueducts.

Energy resources totaled 10,345,060 MWh which included generation of 6,975,500 MWh from SWP energy resources, purchases of 808,500 MWh, other resources of 532,280 MWh, and 2,028,780 MWh of SCE return additional (see Figure 4). Energy loads of 10,345,060 MWh include sales of 6,899,760 MWh, 3,276,770 MWh used to deliver water to SWP contractors, and losses and system imbalances of 168,530 MWh (see Figure 6).

SWP facilities delivered 3,778,547 AF of water to 43 agencies, including 27 long-term water contractors, in 1998 as shown on Table 2. This amount is approximately 890 TAF less than total State and federal water deliveries from the SWP in 1997. State contractor deliveries were 1,736,350 AF; including 1,545,329 AF of entitlement water and 191,021 AF of other water; excluding Joint Facilities and prior water right deliveries. See the "Water Deliveries and Aqueduct Operations" section for more details on water deliveries.

**Map 2**  
**Field Division Boundaries**



**Table 1. Project Pumping by Plant**  
**1998**

(in acre-feet)

Pumping Plants	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Hyatt	17,274	1,496	0	0	0	0	0	0	0	0	0	0	18,770
Thermalito	28,149	3,233	0	0	0	0	0	0	0	0	0	0	31,382
Barker Slough	1,383	2,589	2,161	2,220	2,316	3,370	5,690	5,857	4,323	2,080	1,659	2,820	36,468
Cordelia	1,221	1,541	1,444	1,742	2,149	2,083	2,493	2,723	2,343	1,739	1,475	2,610	23,563
Banks													
State	196,584	7,285	14,315	1,871	43,225	128,947	213,401	263,272	266,204	280,894	129,489	113,836	1,659,323
Federal	0	0	0	0	0	0	0	0	0	13,897	0	14,190	28,087
Total	196,584	7,285	14,315	1,871	43,225	128,947	213,401	263,272	266,204	294,791	129,489	128,026	1,687,410
South Bay	3,655	419	534	942	7,243	12,352	13,988	12,800	9,383	5,119	4,575	7,126	78,136
Del Valle	0	0	0	0	0	0	0	0	0	0	0	666	666
Gianelli 1/													
State	128,784	-134	12	1,252	3,437	1,481	11,004	0	58,619	123,995	58,052	19,927	406,429
Federal	154,443	161,124	8,494	5,592	67,434	2,284	0	0	48,134	148,389	97,026	0	692,920
Total	283,227	160,990	8,506	6,844	70,871	3,765	11,004	0	106,753	272,384	155,078	19,927	1,099,349
O'Neill 2/													
State	0	0	12,497	1,513	0	0	0	0	0	0	0	0	14,010
Federal	212,362	169,034	90,596	64,341	113,498	123,445	139,532	37,659	75,023	166,022	101,455	0	1,292,967
Total	212,362	169,034	103,093	65,854	113,498	123,445	139,532	37,659	75,023	166,022	101,455	0	1,306,977
Dos Amigos 1/													
State	117,571	19,314	42,839	37,938	48,795	105,301	290,048	351,262	191,476	122,619	56,817	88,491	1,472,471
Federal	71,371	25,667	62,702	59,894	59,834	126,566	225,875	166,967	69,105	37,331	34,462	70,462	1,010,236
Other 4/	0	0	0	0	0	0	0	0	0	13,273	232	0	13,505
Total	188,942	44,981	105,541	97,832	108,629	231,867	515,923	518,229	260,581	173,223	91,511	158,953	2,496,212
Las Perillas	2,744	1,643	5,890	8,312	9,590	16,838	23,200	21,913	12,966	7,702	3,237	3,780	117,815
Badger Hill	2,968	1,764	6,278	8,088	9,304	16,911	24,828	23,213	13,789	7,702	3,237	3,780	121,862
Devil's Den	1,186	1,072	1,318	1,346	1,223	2,208	2,780	2,873	2,454	2,355	1,526	1,112	21,453
Bluestone	1,088	972	1,216	1,293	1,224	2,210	2,824	2,898	2,486	2,392	1,554	1,129	21,286
Polonio Pass	1,236	1,110	1,371	1,421	1,303	2,257	2,867	2,954	2,521	2,447	1,601	1,162	22,250
Buena Vista	40,498	10,427	19,581	61,630	64,090	82,303	110,770	128,235	83,690	66,230	27,586	16,553	711,593
Teerink	39,300	8,275	15,846	60,358	60,186	70,069	89,103	106,483	75,581	62,055	26,064	14,045	627,365
Chrisman	38,235	8,117	14,468	58,392	55,453	62,992	80,393	99,133	71,453	58,358	24,457	12,461	583,912
Edmonston	38,149	8,050	13,471	57,728	52,814	59,989	74,998	94,951	68,982	57,127	24,766	13,096	564,121
Oso	18,787	8,107	0	0	0	4,308	20,531	26,635	19,194	17,922	7,647	204	123,335
Castaic 3/	52,864	35,879	50,544	69,796	93,949	112,755	139,908	119,661	93,084	107,379	86,147	77,207	1,039,173
Pearblossom	13,968	461	11,300	52,629	44,722	44,342	40,378	53,294	39,592	30,281	12,746	8,889	352,602

1/ Joint state-federal facility.

2/ O'Neill Pumping Plant is a federal facility.

3/ Pumping at Castaic Pumping Plant is for the city of Los Angeles.

4/ Pumping at Dos Amigos for Cross Valley Canal and delivered to Westlands Water District.

## *Project Status in 1998*

### *Project Facilities*

The SWP conserves water for distribution to much of California's population and to irrigated agriculture. It also provides flood control, water quality control, electrical power generation, new recreational opportunities, and enhancement of sport fisheries and wildlife habitat.

SWP facilities in operation during 1998 included: 27 water storage facilities, 3 pumping-generating plants, 5 power plants, 17 pumping plants, and nearly 600 miles of aqueduct.

The SWP begins with three small lakes on the Feather River tributaries: Lake Davis, Frenchman Lake, and Antelope Lake. The branches and forks of the Feather River flow into Lake Oroville, the SWP's principal reservoir with a capacity of about 3.5 MAF. From Oroville, water flows through a complex system of powerplants, then down the Feather River into the Sacramento River before reaching the Delta. From the northern Delta, water is supplied to Napa and Solano counties through the North Bay Aqueduct.

Near Byron, in the southern Delta, the SWP diverts water into Clifton Court Forebay for delivery south of the Delta. The Banks Pumping Plant lifts water into Bethany Reservoir. It is then lifted by the South Bay Pumping Plant into the South Bay Aqueduct. Through the South Bay Aqueduct water is supplied to Alameda and Santa Clara Counties. Most of the water from the Bethany Reservoir, however, flows into the Governor Edmund G. Brown California Aqueduct. At O'Neill Forebay, part of the water is pumped through the Gianelli Pumping-Generating Plant for storage in San Luis Reservoir until needed. DWR's share of storage in the reservoir is 1,062,183 AF.

Water not stored in San Luis Reservoir continues its flow south and is raised 1,069 ft by four pumping plants: Dos Amigos, Buena Vista, Teerink, and Chrisman. In the southern San Joaquin Valley, the Coastal Branch Aqueduct serves agricultural areas west of the California Aqueduct. At the Tehachapi Mountains, Edmonston Pumping Plant raises the water 1,926 ft and the water enters 8.5 miles of tunnels and siphons. Once the water has crossed the Tehachapi Mountains, it flows through the California Aqueduct into the Antelope Valley.

The California Aqueduct then divides into two branches, the East Branch and West Branch. The East Branch carries water through the Antelope Valley into

Silverwood Lake. From Silverwood Lake, the water enters the San Bernardino Tunnel and drops 1,418 ft into Devil Canyon Powerplant, then to Lake Perris, SWP's southernmost reservoir.

Water in the West Branch flows through Warne Powerplant into Pyramid Lake. From Pyramid Lake the water flows through the Angeles Tunnel and Castaic Powerplant into Castaic Lake, terminus of the West Branch. For the location of facilities cited here, see Map 1.

Lake Oroville and San Luis Reservoir are the primary conservation facilities of the SWP's 27 dams and reservoirs. The remaining 25 dams and reservoirs are used principally to regulate the conserved supply into water delivery patterns designed to fit local needs. Of those 25, the five largest are Lake Del Valle, located in Alameda County; and Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris, in Southern California. Lake Del Valle is approximately four miles from the city of Livermore. The four southern reservoirs--Pyramid Lake, Castaic Lake, Silverwood Lake, and Lake Perris--are near the metropolitan areas of southern California, where water supplies are mainly imported. Information about these reservoirs, including amounts of unimpaired runoff to Lake Oroville and storage levels for SWP's conservation, and other storage facilities are summarized in this report.

### *Outages and Limitations*

Major outages, construction, and operating limitations of SWP facilities during 1998 were:

#### *January*

- Banks Pumping Plant Unit 7 out of service from January 3 to February 2 for discharge valve repair.
- Devil Canyon Powerplant Unit 1 out of service from January 5 to February 6 for annual maintenance.
- Gianelli Pumping-generating Plant Unit 7 out of service from January 12 to May 1 for biennial maintenance.
- Gianelli Pumping-generating Plant Unit 8 out of service from January 12 to April 2 for biennial maintenance.
- South Bay Pumping Plant Unit 4 out of service from January 14 to February 9 for wiring modification and preventive maintenance.



## Table 2. Water Deliveries 1962-1998

(in acre-feet)

Agency	1962-1993	1994	1995	1996	1997	1998	TOTALS
<b>Oroville Field Division</b>							
Last Chance Creek W.D. (Local Supply)	214,483	8,921	8,919	11,404	12,590	10,046	266,363
Plumas Co. F.C. & W.C.D.*	9,081	492	308	360	231	469	10,941
County of Butte*	7,095	329	203	257	189	528	8,601
Thermalito I.D. (Local Supply)	30,475	2,318	2,321	2,613	1,730	2,271	41,728
Prior Water Rights Deliveries 1/	20,429,816	863,831	849,324	921,737	991,710	860,421	24,916,839
Yuba City*	3,439	1,035	910	820	1,005	1,054	8,263
<b>Delta Field Division</b>							
Napa CO. F.C. & W.C.D. *(Local Supply) 5/	145,872	6,792	5,182	4,893	4,341	5,359	172,439
Alameda Co. W.D.* (Local Supply)	602,553	22,911	23,085	23,850	25,022	26,580	724,001
A.C.F.C. & W.C.D., Zone 7* (Local Supply)	527,520	37,190	42,171	37,582	40,372	37,044	721,879
Pleasanton Township W.D.	674	0	0	0	0	0	674
Santa Clara Valley W.D.*	1,742,136	69,495	28,756	44,850	60,601	39,610	1,985,448
Marin W.D.	4,594	0	0	0	0	0	4,594
San Francisco W.D.	82,286	0	0	0	0	0	82,286
Skylonda M.W.D.	10	0	0	0	0	0	10
Oak Flat W.D.*	135,343	3,831	5,169	4,904	5,238	4,286	158,771
Mustang W.D.	4,256	0	0	0	0	0	4,256
Granite Construction	120	0	0	0	0	0	120
Lake Del Valle ( E.B.R.P.D. )	2,442	168	146	150	155	0	3,061
Orestimba Creek	100	0	0	0	0	0	100
Recreation Fish and Wildlife	0	4,397	0	0		114	4,511
CVP Water	5,359	211	213	298	376	513	6,970
Solano Co. F.C.W.C.D.*	134,064	30,990	21,345	29,999	33,530	29,766	279,694
<b>San Luis Field Division</b>							
Dept. Parks & Rec. ( STATE )	912	77	67	76	93	72	1,297
Dept. Fish & Game ( STATE )	7,651	640	651	753	270	336	10,301
Fed. Customers ( Rec.+ Joint-Use )	26,150,764	960,626	1,207,876	1,491,450	1,493,362	1,013,030	32,317,108
Fed. Customers (Misc.)	248,043	108	50	348	43	7,117	255,709
Westlands Water District	10,900	0	0	0	0	136,519	147,419
<b>San Joaquin Field Division</b>							
Tulare Lake Basin W.S.D.*	2,737,981	85,029	139,869	238,070	20,469	17,677	3,239,095
Empire West Side I. D.*	82,998	1,666	1,631	1,868	0	542	88,705
County Of Kings*	57,706	2,116	4,000	4,000	0	15	67,837
Hacienda W.D. 2/	75,895	0	0	0	0	0	75,895
Kern County Water Agency*	19,284,206	700,996	1,066,723	1,022,516	841,319	757,771	23,673,531
Kern Water Bank 4/	7,501	0	0	0	0	0	7,501
Dudley Ridge Water District*	1,284,815	32,419	45,485	53,353	68,638	55,450	1,540,160
Devils Den Water District	339,947	0	0	0	0	0	339,947
J.G. Boswell	117,430	0	0	0	0	0	117,430
Shell Cal Prod. 3/	85,914	0	0	0	0	0	85,914
Alameda County WD	0	0	0	6,200	10,000	3,780	19,980
A.C.F.C. & W.C.D., Zone 7* (Local Supply)	0	0	0	0	0	5,970	5,970
Green Valley Water District	11,054	0	0	0	0	0	11,054
Federal Wheeling	1,182,678	48,370	9,725	9,206	11,272	14,081	1,275,332
Castaic Lake Water Agency	4,157	9,422	9,486	14,052	4,870	311	42,298
M.W.D. Of S.C.	50,092	0	50,000	95,000	126,486	69,234	390,812
Santa Clara Valley WD	0	0	0	45,000	35,000	23,800	103,800
San Luis Obispo County	0	0	0	0	1,099	3,592	4,691
Santa Barbara County	0	0	0	0	7,439	18,618	26,057
Central Coastal Water Authority	0	0	0	86	527	0	613
Department of Fish and Game	0	0	42	0	0	0	0
<b>Southern Field Division</b>							
A.V.E.K. W.A.*	756,655	50,552	48,513	57,672	63,729	54,271	1,031,392
M.W.D. Of S.C.*	13,281,959	807,946	386,042	498,380	586,537	363,052	15,923,916
Littlerock Creek I. D.*	10,731	1,098	480	494	444	404	13,651
Mojave Water Agency*	80,915	16,253	7,495	6,111	12,638	4,580	127,992
Desert Water Agency*	440,127	23,257	38,100	102,622	69,990	70,647	744,743
Coachilla Valley Water District*	274,289	14,102	23,100	62,219	68,340	85,709	527,759
Crestline-Lake Arrowhead Water Agency*	26,632	1,193	884	1,209	1,138	704	31,760
San Gabriel Valley M.W.D.*	150,198	15,230	12,922	15,989	18,175	9,310	221,824
San Bernardino Valley M.W.D.*	261,181	9,135	696	6,064	9,654	1,878	288,608
Santa Barbara	1,240	0	0		0	0	1,240
Dept. Parks & Rec., L.A. Co. Rec. Dept.	57,539	2,918	1,669	2,928	3,624	1,585	70,263
Piru Creek Fish Enhancement	2,915	0	0		0	0	2,915
Castaic Lake Water Agency*	178,661	14,919	17,747	19,704	22,842	19,782	273,655
Palmdale Water District*	45,130	8,418	6,961	11,434	11,861	8,752	92,556
United Water C.D. (Local Supply)	998	0	0	0	0	0	998
Ventura County FCD*	5,824	0	0	0	1,850	1,850	9,524
Los Angeles Dept. of Water and Power	16	0	1,479	0	0	0	1,495
Lilico Pictures	10	0	0	0	0	0	10
<b>Totals</b>	<b>91,397,382</b>	<b>3,859,401</b>	<b>4,069,745</b>	<b>4,850,521</b>	<b>4,668,799</b>	<b>3,768,500</b>	<b>112,614,348</b>

\* Long-term contractors

1/ Includes Thermalito Afterbay, Palermo Canal, Upper Feather lakes deliveries.

2/ Hacienda Water District was annexed by Tulare Lake Basin WSD in 1981.

3/ Repayment of preconsolidation water.

4/ Advance storage of ground water, by agreement between KCWA and DWR

5/ Includes 237 AF of Vallejo Permit water transferred to Napa.

- Teerink Pumping Plant Unit 3 out of service from January 16 to November 12 for annual maintenance.
- Chrisman Pumping Plant Unit 1 out of service from January 20 extending into 1999 for motor rewind and stay vane replacement.
- South Bay Pumping Plant Unit 3 out of service from January 26 to March 10 for motor replacement.
- Badger Hill Pumping Plant Unit 6 out of service from January 26 to February 26 for pump impeller repair.

### ***February***

- Banks Pumping Plant Unit 7 out of service from February 2 for annual maintenance. Expected to extend into 1999.
- Mojave Siphon Powerplant Unit 2 out of service from February 2 to April 13 for brake refurbishment.
- Thermalito Powerplant Unit 3 out of service from February 2 to March 12 for annual maintenance.
- Pearblossom Pumping Plant Unit 1 and 2 out of service from February 3 to March 4 for transformer KYA repair.
- South Bay Pumping Plant Unit 9 out of service from February 7 to May 12 for discharge valve repair.
- South Bay Pumping Plant Unit 4 out of service from February 9 for motor replacement and pump repair. Completion expected by March 1, 1999.
- Warne Powerplant Unit 1 out of service from February 10 to June 26 for work to prevent silt intrusion.
- Warne Powerplant Unit 2 out of service from February 10 to June 23 for work to prevent silt intrusion.
- Pearblossom Pumping Plant Unit 7 and 9 out of service from February 11 to March 2 for work in Pool 58.
- Pearblossom Pumping Plant Unit 5 out of service from February 16 to March 2 for work in Pool 58.
- Pearblossom Pumping Plant Unit 4 out of service from February 17 to March 2 for work in Pool 58.
- Devil's Den Pumping Plant Unit 6 out of service from February 26 to March 18 for discharge valve repair.

### ***March***

- Edmonston Pumping Plant Unit 5 out of service from March 2 to May 5 for unit breaker replacement.
- Pearblossom Pumping Plant Unit 4 and 5 out of service from March 4 to March 23 for transformer KYB testing.
- Pearblossom Pumping Plant Unit 7 and 9 out of service from March 5 to March 20 for repairs on Unit 9's discharge valve and Line No. 3.
- Las Perillas Pumping Plant Unit 4 out of service from March 10 to April 10 for annual maintenance.
- Badger Hill Pumping Plant Unit 6 out of service from March 12 to April 3 for impeller repair.
- Thermalito Powerplant Unit 2 out of service from March 16 to April 23 for annual maintenance.
- South Bay Pumping Plant Unit 7 out of service from March 25 to June 2 for motor replacement.
- Badger Hill Pumping Plant Unit 1 out of service from March 27 to April 10 for installation of motor surge protection equipment.

### ***April***

- South Bay Pumping Plant Unit 2 out of service from April 1 to April 30 for wiring modifications.
- Reid Gardner Powerplant (NV) Unit 4 out of service from April 4 to May 1 for annual maintenance.
- Las Perillas Pumping Plant Unit 5 out of service from April 10 to May 5 for annual maintenance.
- Thermalito Powerplant Unit 4 out of service from April 27 to July 23 for annual maintenance.
- Barker Slough Pumping Plant Unit 5 out of service from April 28 to May 14 for deferred maintenance response

### ***May***

- Banks Pumping Plant Unit 1 out of service from May 1 to June 12 for annual maintenance.
- Gianelli Pumping-Generating Plant Unit 5 out of service from May 8 for stator rewind and unit breaker replacement. Completion expected by August 25, 1999.
- Pearblossom Pumping Plant Unit 4 out of service from May 14 to June 2 for annual maintenance.
- Mojave Siphon Powerplant Unit 1 out of service from May 18 to June 16 for cooling water system repairs.

- Banks Pumping Plant Unit 6 out of service from May 25 to June 23 for intermediate guide bearing replacement.

### *June*

- Gianelli Pumping-Generating Plant Unit 5 out of service from June 1 to June 18 for high-speed rotor amortisseur winding repair.
- Thermalito Diversion Dam Powerplant Unit 1 out of service from June 2 to July 3 for annual maintenance.

### *July*

- South Bay Pumping Plant Unit 6 out of service from July 13 for pump replacement and motor repair. Completion expected by September 1, 1999.
- Banks Pumping Plant Unit 8 out of service from July 20 to October 1 for annual maintenance.
- Chrisman Pumping Plant Unit 4 out of service from July 21 to August 6 for testing and cleaning up smoke damage.
- Chrisman Pumping Plant Unit 9 out of service from July 21 to September 2 for discharge valve repairs.
- Chrisman Pumping Plant Unit 5 out of service from July 24 to August 6 for transformer KYB repair.
- Dos Amigos Pumping Plant Unit 5 out of service from July 28 for shaft and rotor rim repair. Completion expected by June 30, 1999.

### *August*

- Mojave Siphon Powerplant Unit 1 out of service from August 1 to August 14 for defective relay replacement.
- Mojave Siphon Powerplant Unit 3 out of service from August 17 for work on Line No. 3. Completion expected by March 9, 1999.
- Chrisman Pumping Plant Unit 8 out of service from August 18 to September 2 for work on Unit 9.
- Devil's Den Pumping Plant Unit 1, 2, and 3 out of service from August 26 to September 30 for repair of transformer KYA.

### *September*

- Chrisman Pumping Plant Unit 9 out of service from September 2 for pump repairs. Completion expected by March 10, 1999.
- Barker Sough Pumping Plant Unit 6 out of service from September 11 to September 25 for mechanical shaft seal replacement.

- Chrisman Pumping Plant Unit 4 out of service from September 14 to October 2 for impeller and stay vane repair.

- Gianelli Pumping-Generating Plant Unit 5 out of service from September 7 to October 9 for installation of main unit breakers.

### *October*

- Hyatt Powerplant Unit 1 out of service from October 1 to November 5 for annual maintenance.
- Thermalito Powerplant Unit 2 out of service from October 5 to December 8 for annual maintenance and exciter repair.
- Edmonston Pumping Plant Unit 14 out of service from October 5 to October 30 for motor breaker retrofit.
- Pine Flat Powerplant Unit 2 out of service from October 7 to November 20 for annual maintenance.
- Oso Pumping Plant Unit 5 out of service from October 11 to November 24 for testing and contact adjustment.
- Devil's Den Pumping Plant Unit 4 out of service from October 11 to October 26 for discharge valve repair.
- Chrisman Pumping Plant Unit 8 out of service from October 13 to October 28 for air release valve and controller replacement.
- Oso Pumping Plant Unit 7 out of service from October 13 for rotor pole replacement. Expected to extend into 1999.
- Pearblossom Pumping Plant Unit 7 out of service from October 22 for pump casing and wear ring repair. Completion expected by July 14, 1999.
- Teerink Pumping Plant Unit 1 out of service from October 26 for annual maintenance. Completion expected by August 30, 1999.
- Badger Hill Pumping Plant Unit 1 out of service from October 28 for annual maintenance. Completion expected by February 5, 1999.
- Badger Hill Pumping Plant Unit 6 out of service from October 26 to November 25 for biennial maintenance.

### *November*

- Dos Amigos Pumping Plant Unit 4 out of service from November 2 to November 25 for biennial maintenance.

- Gianelli Pumping-Generating Plant Unit 3 and 4 out of service from November 2 to December 12 for installation of main unit breakers.
  - Hyatt Powerplant Unit 2 out of service from November 9 for annual maintenance. Completion expected by January 14, 1999.
  - Devil Canyon Powerplant Unit 3 out of service from November 9 to December 14 for annual maintenance.
  - South Bay Pumping Plant Unit 9 out of service from November 12 for pump repairs. Completion expected by July 17, 1999.
  - Dos Amigos Pumping Plant Unit 3 out of service from November 12 to December 14 for vane control system inspection.
  - Badger Hill Pumping Plant Unit 2 out of service from November 19 for annual maintenance. Completion expected by February 9, 1999.
  - Polonio Pass Pumping Plant Unit 6 out of service from December 3 for discharge valve repair. Completion expected by May 30, 1999.
  - Dos Amigos Pumping Plant Unit 6 out of service from December 4 for biennial maintenance. Completion expected by January 8, 1999.
  - Buena Vista Pumping Plant Unit 5 out of service from December 4 for impeller replacement. Expected to extend into 1999.
  - Thermalito Powerplant Unit 3 out of service from December 14 for annual maintenance and exciter repair. Completion expected by February 4, 1999.
  - Mojave Siphon Powerplant Unit 2 out of service from December 15 for work on Line No. 2. Completion expected by May 3, 1999.
  - Banks Pumping Plant Unit 8 out of service from December 19 for discharge valve repair. Completion expected by January 22, 1999.
  - Dos Amigos Pumping Plant Unit 3 out of service from December 24 for testing and vibration monitoring equipment. Completion expected by January 29, 1999.
  - Chrisman Pumping Plant Unit 2 out of service from December 28 for pump-case inspection and air-valve replacement. Completion expected by January 22, 1999.
- December**
- Warne Powerplant Unit 1 out of service from December 1 during Peace Valley Pipeline inspection. Completion expected by February 28, 1999.
  - Warne Powerplant Unit 2 out of service from December 1 for annual maintenance and during Peace Valley Pipeline inspection. Completion expected by February 28, 1999.

## *Water Supply Conditions*

The SWP meets its contractual obligations by monitoring precipitation and calculating runoff to coordinate the operation of the complex system of dams and reservoirs. Information on those activities is based on the water supply conditions of the 1998 calendar year and the 1997-98 water year.

Runoff in the 1997-98 water year in the Central Valley rivers was less than in 1983 (the wettest year recorded in the 20<sup>th</sup> century) or 1995. However, 1998 runoff was about 20 percent more than in 1997. Total runoff for the eight major rivers of the Sacramento-San Joaquin River system was nearly 42 MAF, about 175 percent of average and the sixth wettest of record.

Water year 1997-98 was the fourth wet year in a row for Northern California. The year was affected by a strong El Nino in the eastern tropical Pacific Ocean that produced above-average precipitation in California, especially and central and southern portions of the

State. It was a year of big snowpacks and abundant snowmelt runoff.

In contrast to 1997, coastal watersheds and smaller basins generated the larger floods of 1998. New flood peaks were observed on the Pajaro River near Watsonville, the Cuyama River above Twitchell Reservoir, at Clear Lake, Farmington and Los Banos reservoirs, and on Merced area creeks. The upper Sacramento Valley was also wet; flooding was comparable to the larger floods of record, despite effective flood control operations at Shasta Reservoir. Flood runoff from major Sierra rivers, including the Feather River, was not unusually large; peak 3-day rates were near median (the rate to be expected in 1 year out of 2).

October started the water year with near-normal precipitation while November was above average, but not unusually wet. December was below average, even with some intense local storms in the South Coast re-

gion during the first weekend of the month. After a slow start in December, the winter turned wet. Both January and February were extremely wet—February precipitation was nearly three times normal. However, the February storms were relatively cool and contributed to a heavy snowpack in the mountains. Some of the largest snowpack percentages were on the ridge separating the Sacramento and Trinity River basins. With the exception of 1995, 1998 had the heaviest snowpack since 1983, another strong El Nino year. The Sacramento River system easily handles snowmelt floods because of its large rain-flood channel capacity. However, San Joaquin River system floodways are only about one-tenth as large and heavy snowmelt years tax the reservoirs and channel systems. Snowmelt in 1998 was delayed about 2 weeks, which helped to control the high San Joaquin River system runoff. The water-supply forecasts were useful for coordinating releases and operating the reservoirs to minimize snowmelt flood damage.

March and April had above-average precipitation, 135 and 125 percent of average, respectively, statewide, but were not nearly as wet as February. May was cool and wet—more typical of March weather. A surprise storm in the upper Sacramento Valley near the end of May produced moderate flood flows in the Sacramento River and the latest occurring inundation of the Sutter and Yolo bypasses observed in a flood season. June started out cool and wet, but in the middle of the month the weather turned dry and remained that way for the rest of the summer. September saw near-normal showers in the mountains. Precipitation percentages are used in this report to express historical and regional comparisons. Additional and more specific information is available via the Internet at: [http://cdec.water.ca.gov/snow\\_rain.html](http://cdec.water.ca.gov/snow_rain.html).

## Water Operations

### Reservoir Operations

Lake Oroville and San Luis Reservoir are the two main conservation facilities for SWP water supplies. Table 8 and Table 13 summarize the operations of these reservoirs during the 1998 calendar year.

Lake Oroville began 1998 with 2,224,172 AF of storage, 704,931 AF less than it held at the beginning of 1997. Storage in Lake Oroville peaked on June 28, 1998 at 3,525,895 AF (99 percent of normal maximum operating capacity) and ended the year at 76 percent of normal capacity or 2,687,877 AF. The net effect of operations and water conditions at Lake Oroville resulted in an increase in storage of 463,704 AF.

At the beginning of 1998, Lake Del Valle held 26,088 AF (65 percent of flood control capacity). Highest end-of-month storage was in May at 40,141 AF (105 percent of flood control capacity). At year's end Lake Del Valle held 24,182 AF (60 percent of flood control capacity).

At the start of 1998, San Luis Reservoir held 1,642,982 AF, 81 percent of its normal maximum operating capacity (2,027,835 AF); the SWP held 993,518 AF, 94 percent of its maximum operating capacity (1,062,183 AF). SWP storage at the end of 1998 increased to 1,074,166 AF. End-of-year federal storage was 824,020 AF, for a year-end total of 1,898,186 AF.

SWP southern reservoirs (Pyramid, Castaic, Silverwood, and Perris) have a combined maximum operating storage capacity of 701,320 AF. The total

combined storage of, 631,104 AF at the beginning of 1998 decreased to 627,710 AF by the end of the year.

The following tabulation compares normal operating capacity in the principal SWP reservoirs with end-of-year storage for 1997 and 1998:

Reservoir	Normal Maximum Operating Capacity	End-of-year Storage 1997	End-of-year Storage 1998
Lake Oroville	3,537,580	2,224,172	2,687,877
Lake Del Valle	77,110	26,088	24,182
San Luis Reservoir	1,062,183	993,518	1,074,166
Pyramid Lake	171,200	167,421	159,283
Silverwood Lake	74,970	69,229	73,707
Lake Perris	131,450	107,367	124,010
Castaic Lake	323,700	287,087	270,710
Totals	5,341,083	3,874,882	4,415,933

### Water Deliveries and Aqueduct Operations

Generally, water diverted from the Sacramento-San Joaquin Delta is delivered to SWP storage facilities and to contractors through Banks Pumping Plant and Barker Slough Pumping Plant for a variety of beneficial uses. In addition to delivering entitlement water to long-term water supply contractors, SWP transports water to other public agencies through exchanges or purchases; provides water for wildlife and recreational uses; and conveys water to meet local water rights agreements. Historical information about water deliv-

eries made to long-term contractors and other agencies through 1998 has been organized in Table 2.

For several years, DWR has offered contractors the opportunity to carry over for delivery during the next year a portion of their entitlement water approved for delivery in the current year. The carry-over program was designed to encourage the most effective use of water, and to avoid obligating the contractors to use or lose the water by December 31. Because operational constraints may change from year to year, an agreement in which the conditions of the approval are listed is signed each year with participating contractors. In 1998, SWP delivered 37,252 AF of entitlement water carried over from 1997 to six contractors, 34,963 AF of which was exchange carryover. Since all the SWP storage facilities were needed for project water, no 1998 carryover water was approved for future delivery.

The Monterey Agreement grew out of water allocation concerns that intensified during the 1987-1992 drought. Rather than negotiate only water allocation issues, the Department and water contractors decided on a major revision to SWP long-term contracts and their administration—in essence, to update management of the SWP. The Monterey Agreement was released to the public December 16, 1994, in the form of 14 principles. *Bulletin 132-95, Chapter 1*, explains the Monterey Agreement in detail.

Make-up water is allocated to contractors according to Article 12(d) and Article 14(b) of the long-term water supply contracts. According to Article 12(d), if for some reason beyond DWR's control, water is not available for delivery according to the established schedule for that year, the water may be delivered at a later date. Article 14(b) of the long-term water supply contracts provides for the delivery of water at a later time if water is not delivered due to necessary investigations, inspections, maintenance, repairs, or replacement of SWP facilities. DWR delivered 17,180 AF of make-up water as defined by Article 14(b) to MWD in 1998.

Under provisions of their water supply contracts, South Bay and San Joaquin Valley contractors may reduce entitlement water deliveries during years in which above-average amounts of local water are available and increase deliveries by an equal amount in later years. No wet-weather credits were given out in 1998.

During 1998, SWP provided water service to 43 agencies, including 27 long-term water contractors. SWP facilities were used to convey non-project water for other agencies, including the CVP. In addition, SWP facilities were used to deliver water transfers, water purchased from the Drought Water Bank, and

transfers from one agency to another. Transfers were accomplished according to agreements negotiated with USBR throughout the year and with participants of existing three-party contracts for the use of the Cross Valley Canal, a water conveyance facility that connects with the California Aqueduct in Kern County.

Total Project (SWP and CVP) deliveries for 1998 totaled 3,768,500 AF. This total includes State contract deliveries of 1,873,338 AF, federal deliveries of 1,034,741 AF, Oroville Complex diversions of 60,421 AF, 10,516 AF of Upper Feather River deliveries, and does not include 71 AF of non-chargeable refill water. State contract deliveries include a total of 1,545,329 AF of entitlement and entitlement-related water to 27 long-term contractors, plus 328,009 AF of other water. A graph showing the historical annual deliveries from SWP facilities is shown in Figure 1. Amounts of 1998 water deliveries are shown by field division on Map 2, and include entitlement water, permit water, local supply, recreation, purchases, wheeling, and water transfers. Totals by agency are shown in Table 2.

The following table is a summary of contract deliveries in 1998:

Entitlement Water		Other Water	
M & I	461,865	Purchase Pool B	75,000
Agricultural	738,609	General Wheeling	7,000
M GW	118,424	Local	43,661
Bypass	37,000	Recreation (State)	2,107
Interruptible	20,288	Transfer Water	1,345
Carryover	2,289	MWD Exchange	2,176
Storage	79,761	Free Flood Water	10,121
Transfer	1,090	Exchange Water	21,000
Exchange	21,000	Flood Water Del.	20,156
Benecia	8,482	USBR Return	8,924
Vallejo	4,378	State transfer to	
Exch Cryover	34,963	Westlands WD	136,519
Art. 14B Make-up	17,180		
<b>Total</b>	<b>1,545,329</b>	<b>Total</b>	<b>328,009</b>
<b>Total Water</b>	<b>1,873,338</b>		

## Significant Operational Activities

### January

- On January 23, a 42-foot steel work boat belonging to DWR sank near the intake structure in Lake Oroville. There was concern for potential escaped diesel fuel on downstream fisheries that instigated extraordinary measures to remove the boat from the Lake.
- A variety of previously discovered leaks in Pool 48 prompted an outage of the East Branch on January

21. This outage continued through March 20 while cracks were repaired in the aqueduct lining. Repairs were also made to the forebay lining at Edmonston Pumping Plant. There was no pumping allowed during daylight hours to accommodate the work.

- A low export fish experiment was conducted in the Delta from January 14 through January 27. SWP and CVP combined exports were held to 3,800 cfs, causing reduced flows at Banks and Check 12. Thermalito Diversion Dam releases remained at 900 cfs during January, which facilitated a multi-year evaluation of, increased flow effects on salmon spawning in the low flow section of the Feather River.
- Beginning on January 22, some of the South Bay Aqueduct's water demands were met by releases from Del Valle Reservoir. There was sufficient precipitation in January to increase the reservoir storage, and consequently limit the ability to conserve local spring runoff. Hyatt-Thermalito operations peaked during this same period with river releases reaching 14,000 cfs.

### **February**

- A powerful storm on February 2 and 3 dumped heavy amounts of rain in the upper Sacramento Valley. West side San Joaquin Valley streams gushed large volumes of flow. A flood alert was declared, and DWR staff was mobilized to provide flood-related forecasting and technical assistance as necessary. Thirty-five counties received presidential disaster declarations by the end of the month. Flows into Clifton Court Forebay, pumping at Banks Pumping Plant and inflow into O'Neill Forebay from the California Aqueduct were all curtailed after February 2 because of excessive amounts of storm water available and low demands by downstream service areas. Los Banos Reservoir made nearly 37 TAF of flood control releases. Peak runoff inflows reaching nearly 2,000 cfs caused 96 TAF of flood gains into the Aqueduct in the Joint-use facilities area alone and required stream releases at Del Valle, Los Banos, Little Panoche, Pyramid, Castaic, and Silverwood Reservoirs. West Branch Reservoirs, Pyramid, Castaic, and Elderberry all filled to capacity.
- From the 17 to the 23, approximately 800 AF was released into O'Neill Forebay through Check 12 as pools 10, 11, and 12 began dewatering to facilitate lining repairs. During the drawdown, it was determined that the embankment was unstable and repairs would need to be made using cofferdams to isolate the affected areas without draining the pools. Numerous other project repairs, including canal liner damage at Pool 48 and forebay liner damage at Ed-

monston, required curtailed pumping south of Buena Vista.

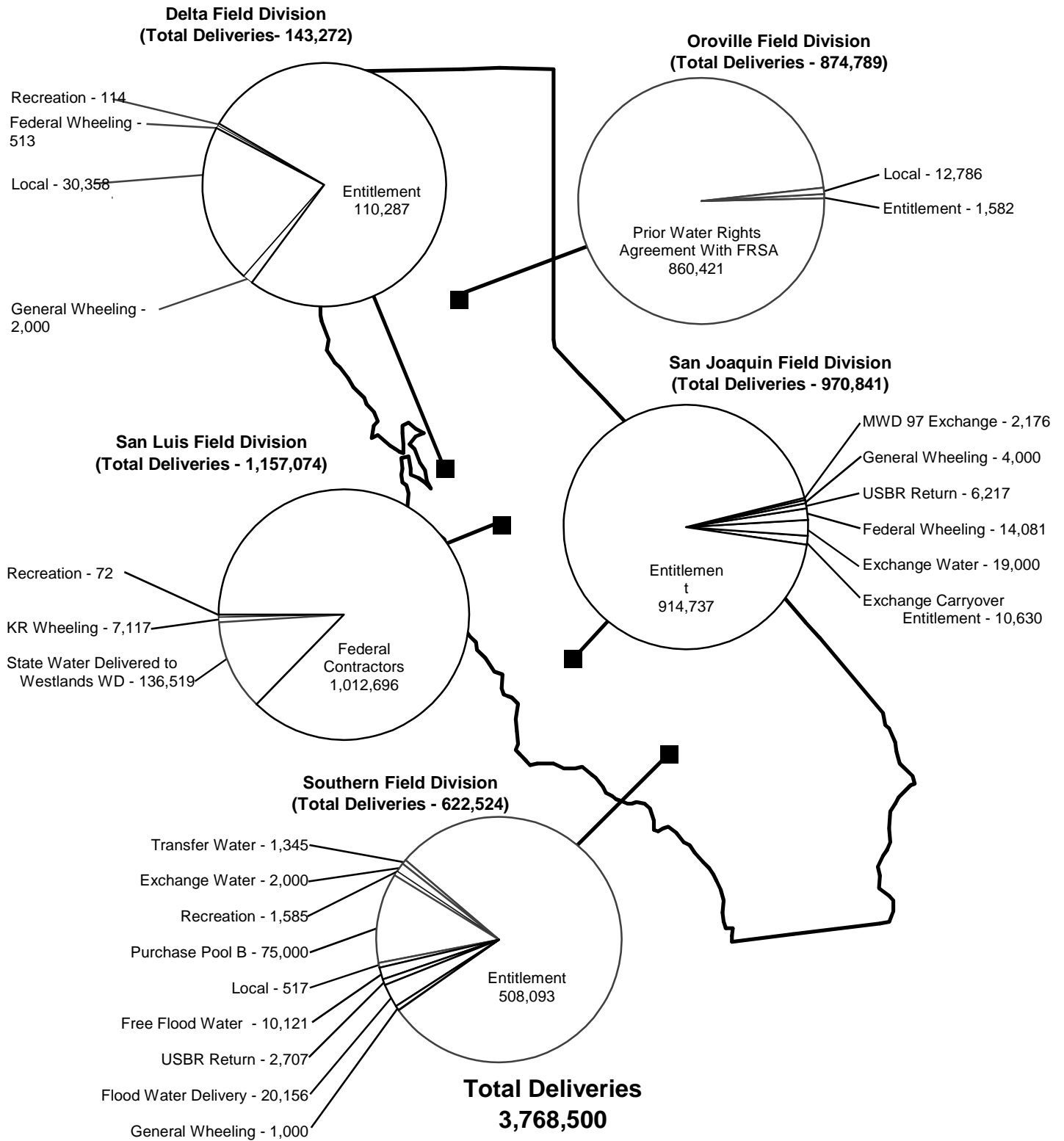
### **March**

- Flood control and storm inflow releases primarily occurred during the first and last weeks of the month. Flood control releases at Castaic Lake during the first two weeks of March totaled about 8,000 AF. Temporary encroachment into flood control space at Oroville prompted the release of 118,445 AF over the controlled spillway during the last seven days of the month. Storm related releases of natural inflow at Perris, Pyramid, Silverwood, and Elderberry Lakes totaled 13,250 AF during the last week of March.
- Pumping at Banks Pumping Plant during the first week of the month allowed water levels at Clifton Court Forebay to be drawn down to elevation -2.50 feet for repairs to the Forebay Dam and Intake Gate 4. Inflow into Clifton Court was terminated while the gates remained closed for the entire month. Earthen coffer dams enabled Pool 10 to be dewatered while repairs were made to the embankment and aqueduct lining.
- Contractors completed work on liner panels at the Edmonston Pumping Plant Forebay on March 11, and on emergency canal lining repairs at Pool 48 on March 18. These repairs required curtailed pumping south of Buena Vista Pumping Plant.

### **April**

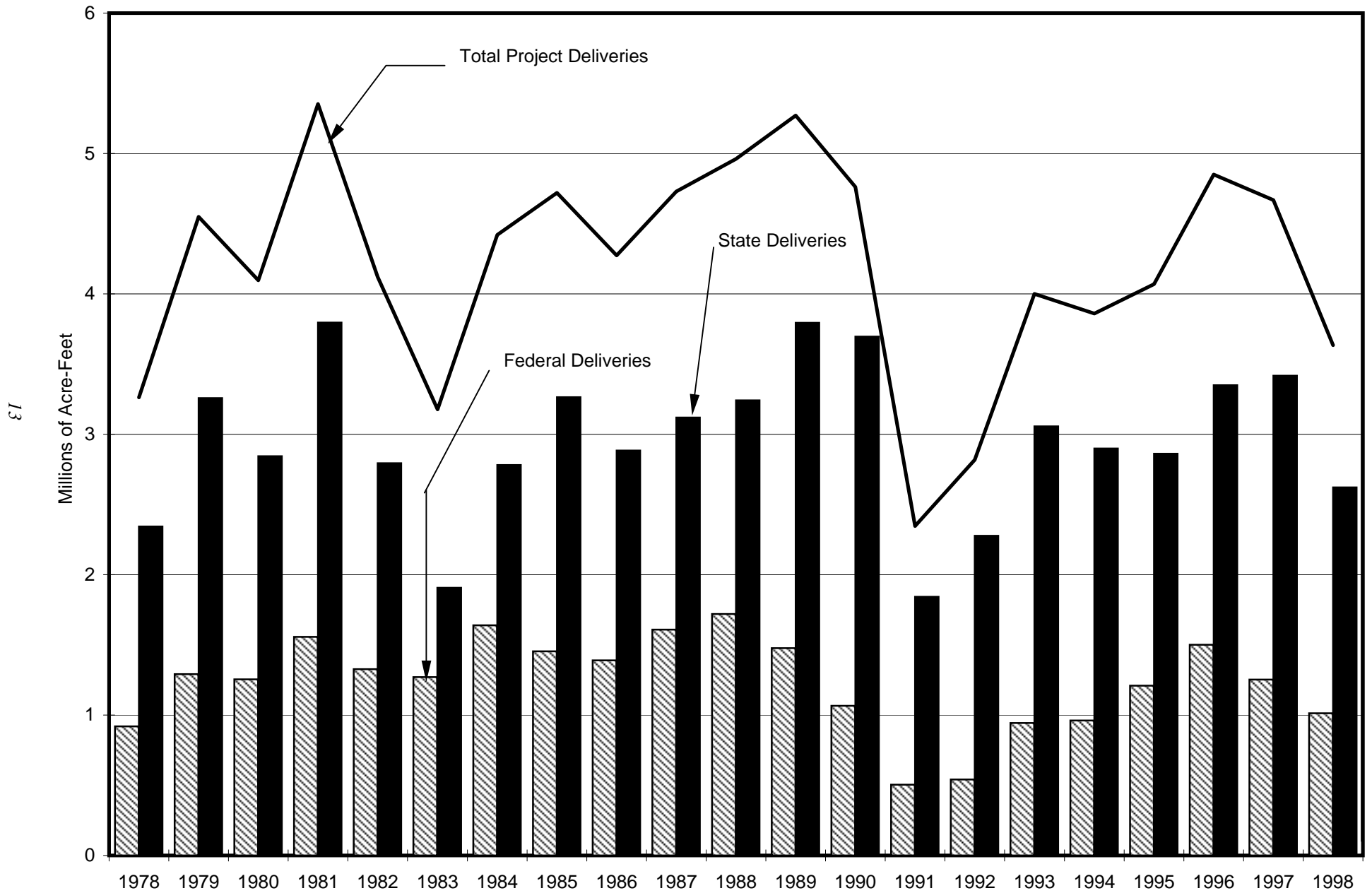
- There were no spillway releases at Lake Oroville in April. Controlled releases during the last week of April at Lakes Antelope and Frenchman were made in order to prevent uncontrolled spill. Colder weather in early April slowed snowmelt run-off which allowed releases to the Feather River to be decreased from 25,000 cfs to 10,000 cfs while keeping the lake storage below flood control requirements.
- At the request of the local reclamation district, the SWP began taking water into the California Aqueduct from the Kern River Intertie the first week of April. This was to assist in moving flood flows from the Kaweah and Tule rivers. The SWP used this water to meet SWP demands south of Pool 29.
- On April 15, the beginning of the spring "pulse" flow period, the San Joaquin River flow was about 25,000 cfs. Tracy exports increased from about 750 cfs, to about 1,900 cfs and remained at that level through the rest of the "pulse" flow period.
- Repair work on cracked canal panels at Mile Post 55 and slope stabilization at Mile Post 52.47 required a 2,000-foot length of canal to be dewatered. Flows at

# **Map 3** **1998 Water Deliveries** (in acre-feet)





**Figure 1. Total Deliveries from SWP Facilities**  
Annual Totals



Check 12 into O'Neill were reduced to zero, while pumping at Banks met South Bay demands only. Pumping for the SWP at Tracy and O'Neill Plants began on March 24 to help meet SWP demands during the outage of the California Aqueduct.

### *May*

- On May 8, flood water inflow to the California Aqueduct through the Kern River Intertie was decreased from 1,400 cfs to approximately 700 cfs, which matched Southern California water demands since Silverwood Lake and Lake Perris were full. Inflow to the Aqueduct was limited to approximately 700 cfs until water demands increased.
- Flood control releases were made from Castaic Lake from May 7 through May 26. Flood control releases were made from Lake Silverwood through the entire month of May.
- Oroville releases to the Feather River were temporarily reduced from 7,000 cfs to 4,000 cfs during the second week of May and coordinated with USBR reduced releases to assist the Nautical Heritage Society's "tall ship" to pass safely under the Business 80 Pioneer Bridge and get to Old Sacramento. The ship's promotional visit was part of the California Sesquicentennial.
- Oroville releases were temporarily increased to 10,000 cfs on May 29 to make room for runoff from a late season storm.
- Repairs to Pool 10 at Mile Post 55 were completed on May 15 and normal aqueduct operations resumed. Approximately 1,000 feet of canal was repaired with waterproof geomembrane and shotcrete.

### *June*

- Lake Oroville filled on June 26, reaching approximately 3,520,000 AF and an elevation of 899 feet. Inflows from snowmelt run-off slowly declined. Releases from Lake Oroville were decreased from 8,000 cfs to 7,000 cfs, matching lake inflows and afterbay deliveries. To assist the field division in removing floating debris, the lake elevation was maintained near full until July 1.
- Floodwater from the Kings, Kaweah, Tule, and Kern Rivers continued to be taken into the California Aqueduct through the Kern River Intertie. About 200,000 AF has been taken in so far this year through a combination of the Intertie and the Cross Valley Canal.
- Generation at Warne Powerplant resumed after being shutdown since February, due to flood flows and sediment build up from Piru Creek.

- Spill, which began in April, continued from both Antelope Lake and Frenchman Lake.

### *July*

- On July 1, the SWP became a "Scheduling Coordinator" with the California Independent System Operator (ISO). The ISO is responsible for the operation of the electrical grid in California and the dispatch of generators that are made available in the day-ahead and hour-ahead markets by scheduling coordinators. SWP sold supplemental energy (Ancillary Service) to the California ISO during the week of July 13-17 as high temperatures throughout the southwest caused higher than expected electrical loads.
- Over the weekend of July 4, Lake Oroville was cleared of debris. Lake Oroville was held at levels that allowed Civil Maintenance to maximize their clean up efforts. Storage in the lake slowly decreased during the month.
- On July 12, a test was conducted at Hyatt, Thermalito and Gianelli plants to determine the maximum generation capacity that could be brought on line in 10 minutes. The test indicated that 541 MW was available from the Hyatt/Thermalito complex and 265 MW at Gianelli.
- On July 13, an herbicide application was done at Clifton Court Forebay to control pondweed growth. To provide the required herbicide contact time, the elevation of Clifton Court was maintained at -1.5 feet for 36 hours with limited pumping at Banks to supply South Bay contractors.
- USBR temporarily decreased pumping at Tracy Pumping Plant due to water level concerns from a south Delta water user. Tracy pumping was decreased to 4 units on July 18. Pumping with all 5 units resumed on July 21 after investigation indicated the problem was most likely caused by local sedimentation and was not significantly impacted by project exports. Additionally, the USBR opened the Cross Channel Gates on July 17.
- The spill at Antelope Lake and Frenchman Lake, which began in April, ended during July.

### *August*

- On August 6, Banks Pumping Plant was available at 8,660 cfs capacity. The plant had been restricted to 8,285 cfs since June 24 due to Skinner Fish Facility's No. 1 effluent pump.
- In response to electrical system demands, DWR supplied "supplemental" energy to the California ISO during the first two weeks of August. Feather River releases were increased to 7,000 cfs during the weekend of August 8-9, providing full load genera-

tion capacity at the Oroville complex during high-energy demand periods. Releases were subsequently decreased to 6,000 cfs as energy demand declined.

- The first phase of the East Branch Flow Test (approximately 1,590 cfs flow at Pearblossom) was conducted August 7-9. The second phase of the test (approximately 2,010 cfs flow at Pearblossom) was conducted August 15-17. The results of the test were still being analyzed.

### ***September***

- The California Independent System Operator declared stage 1 and stage 2 alerts on a daily basis during early September, signaling that system electrical reserves were at or near critical levels during peak load hours. During the first week of September, DWR continued supplying ancillary service supplemental energy and electrical capacity to the California ISO on a daily basis.
- On September 7, in response to the high-energy demands, Feather River releases were increased to 8,000 cfs. By September 11, as cooler weather lowered energy demands, releases were decreased to 5,000 cfs.
- The Skinner Fish Facility was inundated by up to 10,000 mitten crabs per day during the latter part of September. Although the crabs were seen at the fish facility in previous years during this migratory period, they had never amassed to this level. The crabs made fish salvage operations difficult; however, export operations were not significantly affected.
- On September 14, a leak of approximately 9 gallons per minute was discovered in pool 14, Mile 88.51, of the California Aqueduct. This section of the aqueduct has experienced similar leaks in the past. The pool was lowered to minimum, allowing the leak to be repaired.
- Drawdown of approximately 145 AF per day continued at Lake Del Valle throughout the month of September in preparation for flood control.

### ***October***

- Feather River releases were decreased to 2,450 cfs prior to the start of the fall-run salmon spawning period.

- Clifton Court Gate No. 4 was returned to service on October 9. It had been out of service since July 25, 1996.
- During October, staff began the annual maintenance cycle at Hyatt and Thermalito Powerplants with Hyatt Unit 1 and Thermalito Unit 2 taken out of service.
- On October 9, DWR began pumping Cross Valley water for the Bureau of Reclamation. The pumping continued through the month with a final total of 14,418 AF pumped.

### ***November***

- Inflow to Clifton Court Forebay was curtailed from November 23 through November 26 in preparation for tests to determine the ability to measure inflow with acoustic Doppler flow meters.
- Nevada Power Company (Sierra Pacific Resources) interrupted DWR's Reid Gardner Unit 4 Entitlement up to 235 MW daily for peaking needs.
- The fall drawdown of Lake Del Valle was completed. USBR San Luis operations were impacted by the Delta Mendota Canal being taken out of service for maintenance.

### ***December***

- Flood control releases of 26,156 AF were made through the Oroville spillway December 4 through 8.
- East Branch pumping filled Silverwood in preparation for January East Branch outage.
- West Branch was out of service the entire month of December for Lower Quail Canal and Peace Valley Pipeline repairs.
- In December, pipe rollout sections were installed in the Santa Ana Pipeline during an outage. The rollout sections will be used for outages in early 1999 to inspect and repair the Santa Ana Pipeline.
- For two weeks in December, SWP exports were voluntarily curtailed to 2,000 cubic feet per second to facilitate a fishery experiment. Due to relatively low contractor demands and high storage levels at San Luis Reservoir, there were no water supply impacts. The CVP's Tracy Pumping Plant has been out of service since mid-November for cleaning and maintenance of the Delta Mendota Canal.

## ***Energy Operations***

### ***Energy Resources***

All SWP energy resources totaled 6,975,500 MWh and are summarized in Figure 3. Total State energy resources are summarized in Figure 4.

Energy generation from SWP's seven hydroelectric plants (Hyatt, Thermalito, Gianelli, Warne, Castaic, Alamo, and Devil Canyon) during 1998 totaled 4,533,130 MWh.

The SWP receives energy under contract from five small hydroelectric facilities (total capacity of 30 MW) owned and operated by MWDSC. In 1998, these plants furnished 116,490 MWh of energy to the SWP. DWR has exchange arrangements with Southern California Edison and the Los Angeles Department of Water and Power to provide transmission of this energy.

The DWR-SCE Power Contract has been in effect since April 1983. Under this contract, part of the Hyatt Thermalito Power plants' generation and all of the output of Devil Canyon Power Plant and Alamo Power Plant are delivered to SCE. The energy is generally delivered during on-peak periods and a greater amount of energy is returned during off-peak periods. SCE combined return and additional to the SWP during 1998 was 2,028,780 MWh.

Since July 1983, DWR has received energy from Reid Gardner Powerplant, a coal-fired facility near Las Vegas, Nevada. Reid Gardner consists of four units. DWR owns 67.8 percent of Unit 4 (169.5 MW based on nameplate capacity of 250 MW), while Nevada Power Company owns the remainder of Unit 4, as well as all of units 1, 2, and 3. The SWP share of energy generated at the coal-fired Reid Gardner Unit 4 during 1998 totaled 1,382,040 MWh of energy.

Long term contracted energy purchases, such as MWD Hydro, are itemized separately in Table 3. Other purchases totaled 808,500 MWh from various utilities and power marketers, such as Pacific Gas and Electric Company and Enron Power Marketing, Inc.

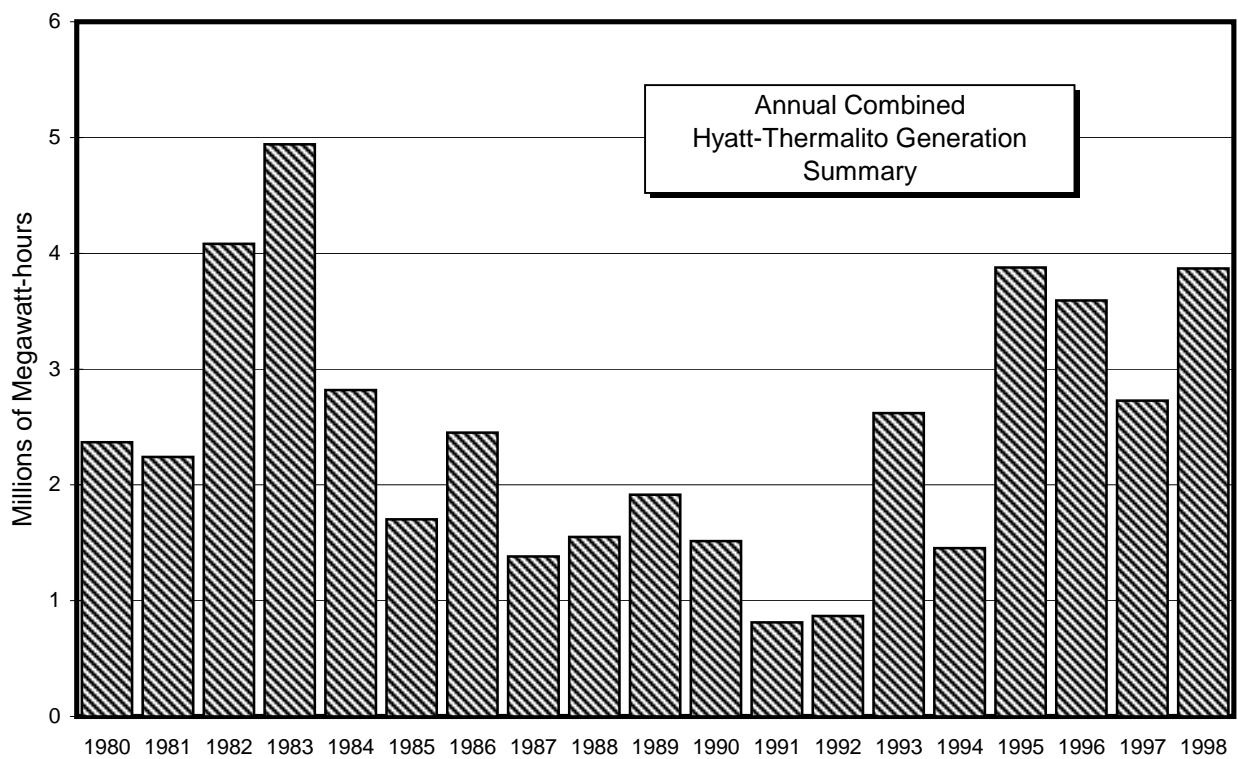
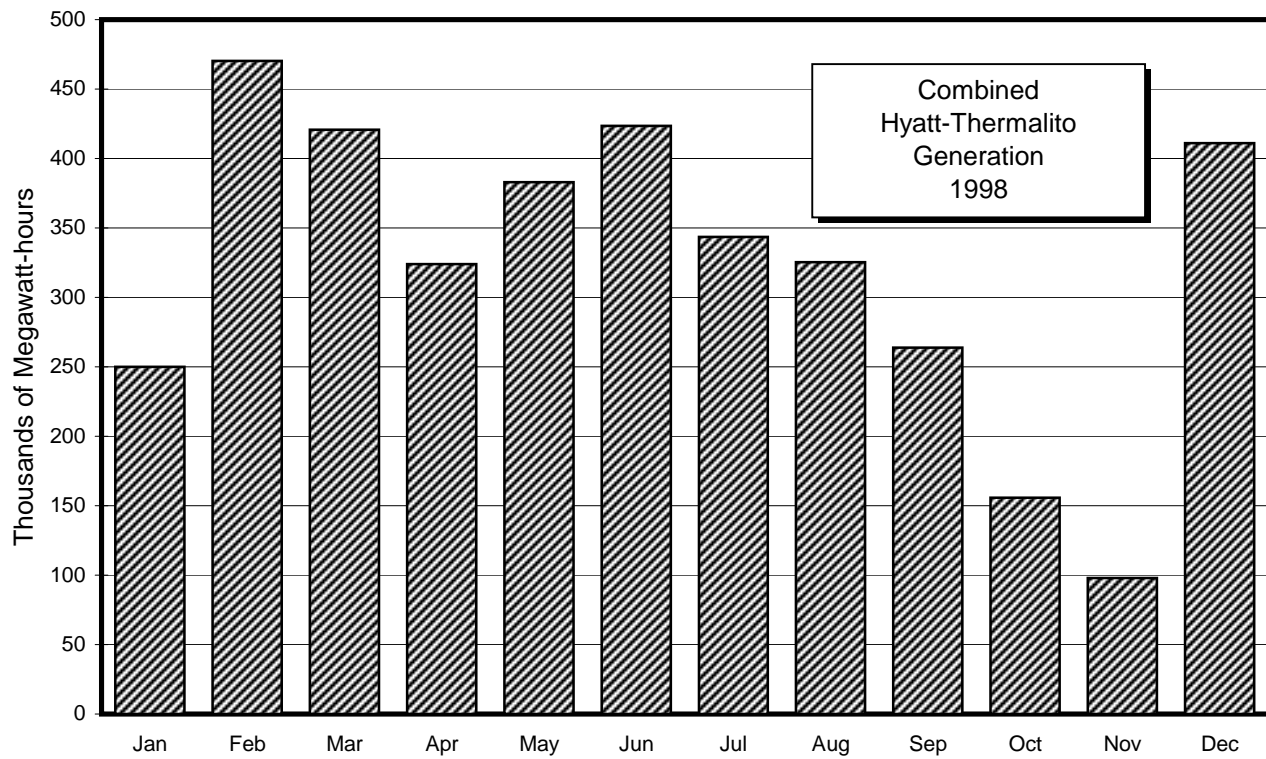
### ***Energy Loads***

Energy load data (total energy used by the SWP) is summarized in Table 4, and Figures 5 and 6. For the purposes of balancing energy resources and loads, this report itemizes those amounts required to meet SWP supplies and demands separately from those amounts required to meet total DWR supplies and demands. Besides SWP energy loads of 3,276,770 MWh, total DWR energy loads include sales of 6,899,760 MWh, and losses and system imbalances of 168,530 MWh, for a total of 10,345,060 MWh.

The San Joaquin Field Division, which includes the only stretch of Aqueduct with no reservoirs, accounted for over half of the total project energy load. Included in this amount is 1,275,490 MWh used at Edmonston Pumping Plant with peak pumping occurring in August.

In 1998, the Department sold power to 36 utilities and 19 power marketers, resulting in revenues of over \$139.35 million. The largest sale was 790,867 MWh to New Energy Ventures, Inc.

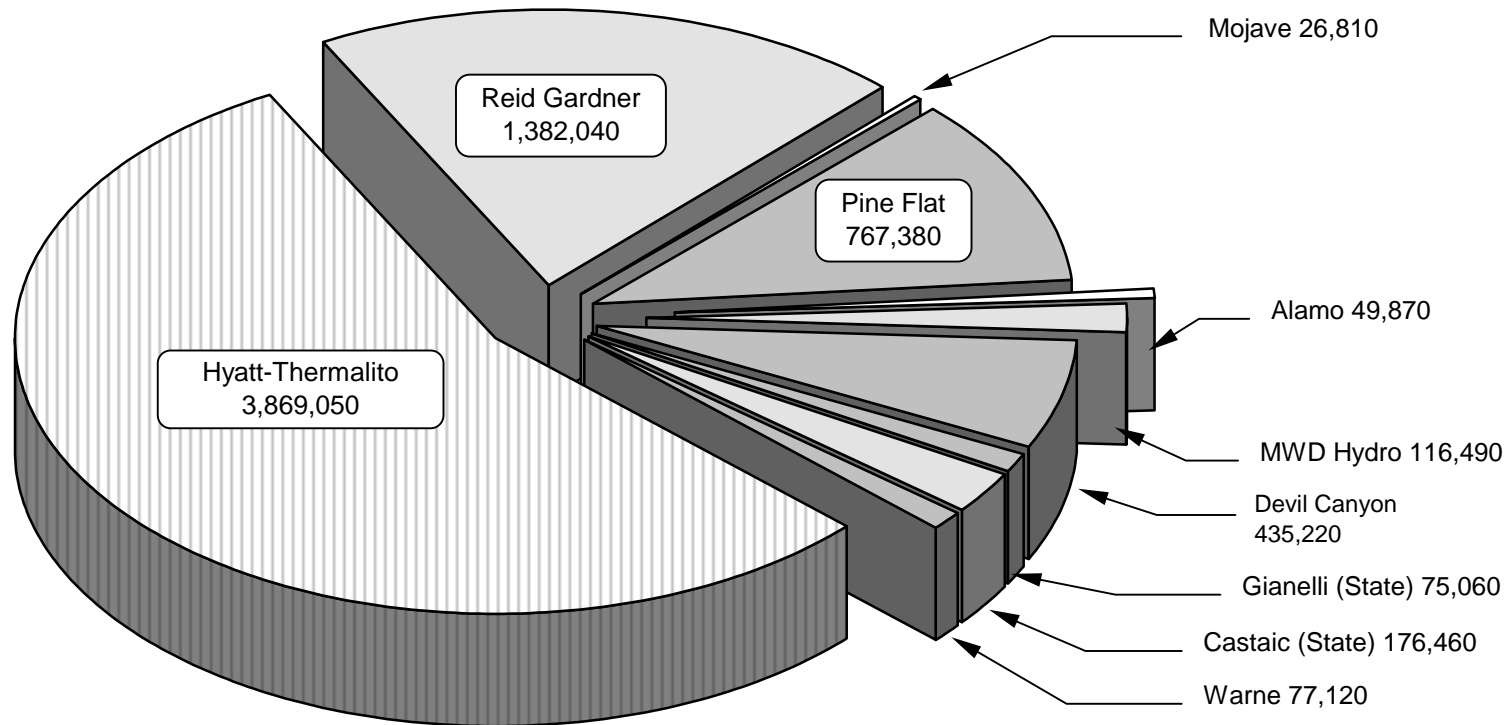
**Figure 2. Combined Operation of Hyatt-Thermalito Powerplants**



**Figure 3. SWP Energy Resources**

(all values in MWh)

**1998**

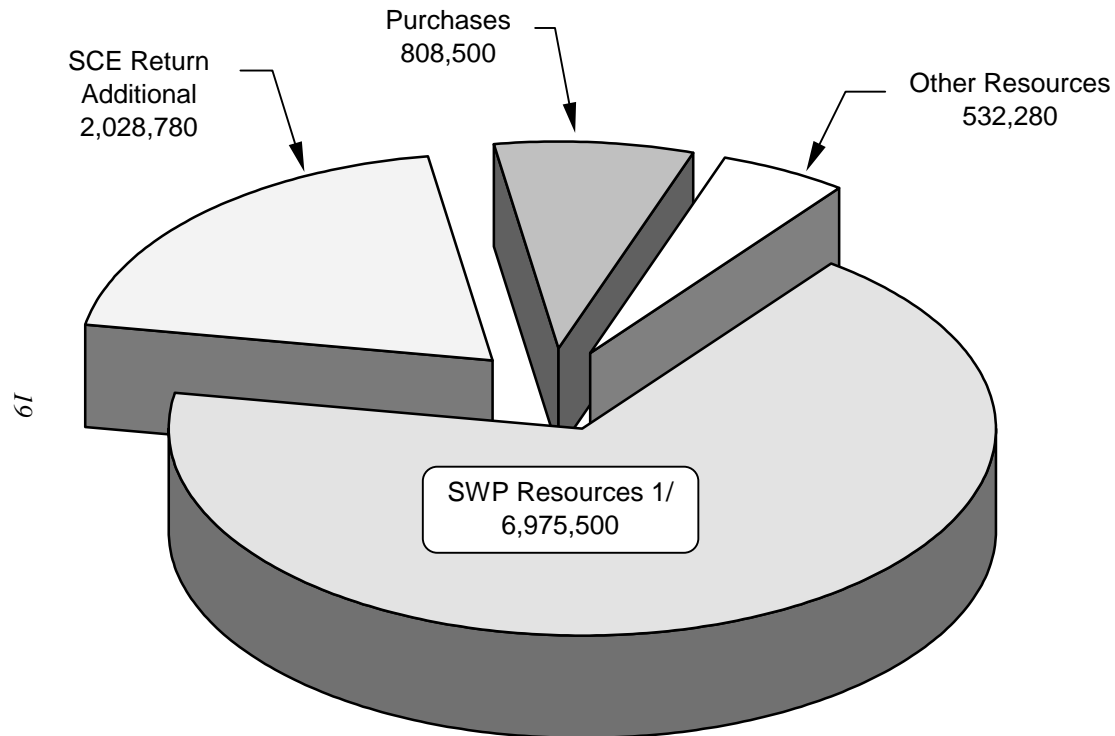


**Total: 6,975,500**

Note: Purchases, Other Sources, and SCE Return Additional are not shown here. All values are metered readings at plants and are not adjusted for transmission losses.

**Figure 4. Total State Energy Resources  
1998**

(All values in MWh)



1/ See Figure 3 for a breakdown of SWP Energy Resources.

Purchases

California Power Exchange	528,550
Enron Power Marketing Inc.	91,820
Duke Energy Trading Marketing	62,150
Pacific Gas & Electric Energy Trading	61,550
Cinergy Capital & Trading, Inc.	31,200
Avista Energy, Inc.	30,580
British Columbia Hydro Powerex	2,110
Pacific Gas & Electric Company	200
Arizona Public Service Company	170
Bonneville Power Administration	170
	<hr/>
	808,500

Other Resources

Pacificorp	612,320
Energy to MWD	-144,490
Energy from MWD	148,410
Power Exchange to Utilities Combine	-497,980
Power Exchange from Utilities Combine	420,100
Power System Deviations	-6,080
	<hr/>
	532,280

SCE Return Additional

Total Received from SCE	4,543,770
SCE Hyatt-Thermalito Entitlement	-2,514,970
	<hr/>
	2,028,800

**Table 3. Total Energy Resources  
1998**

(in megawatt-hours)

Resource	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Hyatt-Thermalito 1/	250,091	470,162	420,670	324,009	383,015	423,400	343,632	325,400	263,784	155,809	97,969	411,109	3,869,050
Gianelli													
State	12,930	0	0	530	0	190	17,250	32,700	6,480	110	0	4,870	75,060
Federal	1	0	0	6,942	7,945	5	35,554	29,224	2,891	-2	6,215	17,608	106,383
Total	12,931	0	0	7,472	7,945	195	52,804	61,924	9,371	108	6,215	22,478	181,443
Warne 2/	12,030	4,700	0	0	0	2,290	12,930	16,550	11,760	12,070	4,790	0	77,120
Castaic	18,480	27,384	11,496	14,437	20,640	13,224	18,840	17,713	13,153	14,783	6,310	0	176,460
Mojave	900	0	912	4,356	3,545	3,062	3,205	4,432	3,027	2,209	640	522	26,810
Alamo	1,917	0	1,590	6,842	6,259	6,551	5,910	7,591	5,757	4,347	1,806	1,300	49,870
Devil Canyon	16,226	10,527	21,929	61,950	52,697	52,153	55,961	60,378	45,390	35,854	13,311	8,844	435,220
Pacificorp	55,200	44,030	46,800	64,700	41,880	46,810	54,780	52,000	51,070	54,000	48,000	53,050	612,320
MWD Hydro	11,790	4,470	7,000	8,630	9,280	11,690	12,490	14,880	13,520	7,440	7,620	7,680	116,490
Reid Gardner	117,390	87,530	113,810	12,310	62,740	98,810	113,970	151,130	131,530	179,320	174,150	139,350	1,382,040
Pine Flat	-140	2,630	48,960	92,670	130,850	129,620	130,880	118,800	53,610	23,640	12,180	23,680	767,380
Purchases 3/	200	170	0	0	0	52,170	82,100	83,200	101,000	251,180	216,070	22,410	808,500
Other Sources/Exchang 4/	-13,240	-2,540	9,330	77,720	55,470	-22,340	-36,940	-38,640	-21,780	-19,820	-41,310	-25,950	-80,040
SCE Return Additional	146,990	-8,340	49,990	69,230	-25,840	43,300	188,680	308,740	290,930	349,270	238,820	377,010	2,028,780

1/ Includes Table Mountain and Hyatt out adjusted to Tesla.

2/ Includes station-service energy.

3/ Includes California Power Exchange, Enron Power Marketing Inc., Duke Energy Trading Marketing, PG&E Energy Trading, Cinergy Capital & Trading, Inc., Avista Energy, Inc., British Columbia Hydro Powerex, PG&E Company, Arizona Public Service Company, Bonneville Power Administration.

4/ Includes City of Azusa, New Energy Ventures, BG&E Energy Trading, PG&E Energy Services, Sempra Energy Trading, Williams Energy Services Co., Sacramento Municipal Utility District, Western Area Power Administration, Enron Power Marketing, Idaho Power Company, Northern California Power Agency, Cinergy Power Marketing and Trading, and Los Angeles Dept. of Water and Power.

Total State: 10,345,060  
Total Federal: 106,383  
Total Energy Resources: 10,451,443



**Table 4. Total Energy Loads**

**1998**

(in megawatt hours)

Source	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals
Hyatt-Thermalito 1/	16,022	1,520	394	25	3	19	10	1	38	64	3	1	18,100
North Bay 2/	820	1,100	960	1,040	1,010	1,210	1,860	2,070	1,660	990	840	1,420	14,980
South Bay	3,060	449	635	1,096	5,824	10,546	12,360	11,252	8,279	4,594	3,817	5,718	67,630
Del Valle	7	7	6	6	6	6	7	7	7	6	6	29	100
Banks													
State	56,120	2,600	8,380	1,400	12,480	36,180	60,120	74,080	75,200	79,320	36,820	32,020	474,720
Federal	0	0	0	0	0	0	0	0	0	0	0	4,215	4,215
Bottle Rock 3/	26	35	40	43	47	40	35	32	30	38	46	58	470
Gianelli													
State	46,400	110	390	690	1,710	860	4,050	290	19,930	44,900	24,320	8,570	152,220
Federal	57,067	63,142	3,264	1,982	29,704	1,224	0	0	16,241	53,793	40,860	0	267,277
Dos Amigos													
State	15,790	2,840	5,390	4,070	6,270	14,790	34,320	50,010	26,780	19,530	10,380	11,930	202,100
Federal	9,160	3,386	8,551	8,862	8,410	16,321	35,838	20,052	8,690	2,897	2,798	10,503	135,468
Pine Flat 3/	137	194	2	0	0	1	0	0	0	0	51	95	480
Las Perillas	208	136	438	580	661	1,218	1,683	1,586	941	600	249	310	8,610
Badger Hill	484	310	1,090	1,534	1,786	3,280	4,703	4,415	2,517	1,592	638	791	23,140
Devil's Den	889	802	987	1,001	924	1,611	2,023	2,086	1,781	1,718	1,125	833	15,780
Bluestone	833	749	924	980	936	1,646	2,082	2,160	1,854	1,785	1,170	871	15,990
Polonio	905	815	1,001	1,020	930	1,621	2,054	2,116	1,820	1,746	1,152	860	16,040
Buena Vista	9,909	2,732	4,860	15,054	15,628	20,188	26,824	31,009	20,217	15,901	6,855	4,263	173,440
Teerink	10,320	2,430	4,400	16,050	15,910	18,420	23,460	27,990	19,790	16,350	7,010	3,930	166,060
Chrisman	23,483	5,597	9,467	36,055	34,632	39,244	49,642	61,975	44,641	36,955	16,030	8,499	366,220
Edmonston	84,270	19,334	31,819	130,388	120,270	134,476	169,093	214,625	155,710	128,061	56,824	30,620	1,275,490
Oso	5,367	2,388	317	263	255	1,374	5,752	7,435	5,427	5,274	2,330	338	36,520
Mojave 3/	60	80	70	10	20	20	20	20	20	20	60	70	470
Pearblossom	9,976	716	7,988	36,145	30,825	30,318	27,616	36,348	26,965	20,757	9,066	6,590	243,310
Warne 3/	100	100	130	130	120	90	100	340	300	370	420	130	2,330
Sales	332,550	582,770	636,020	469,930	469,400	519,090	573,440	621,290	538,650	675,270	593,050	888,300	6,899,760
Alamo 3/	40	80	50	0	0	0	20	30	30	30	30	60	370
Devil Canyon 3/	250	230	170	100	150	160	150	150	150	150	240	300	2,200
Losses and System Imbalances	12,738	12,599	16,559	19,774	20,739	24,522	2,264	3,557	16,494	14,191	7,824	17,269	168,530

1/ Pumpback and Station Service

2/ Includes Barker Slough, Cordelia, and Cordelia Interim Pumping Plants.

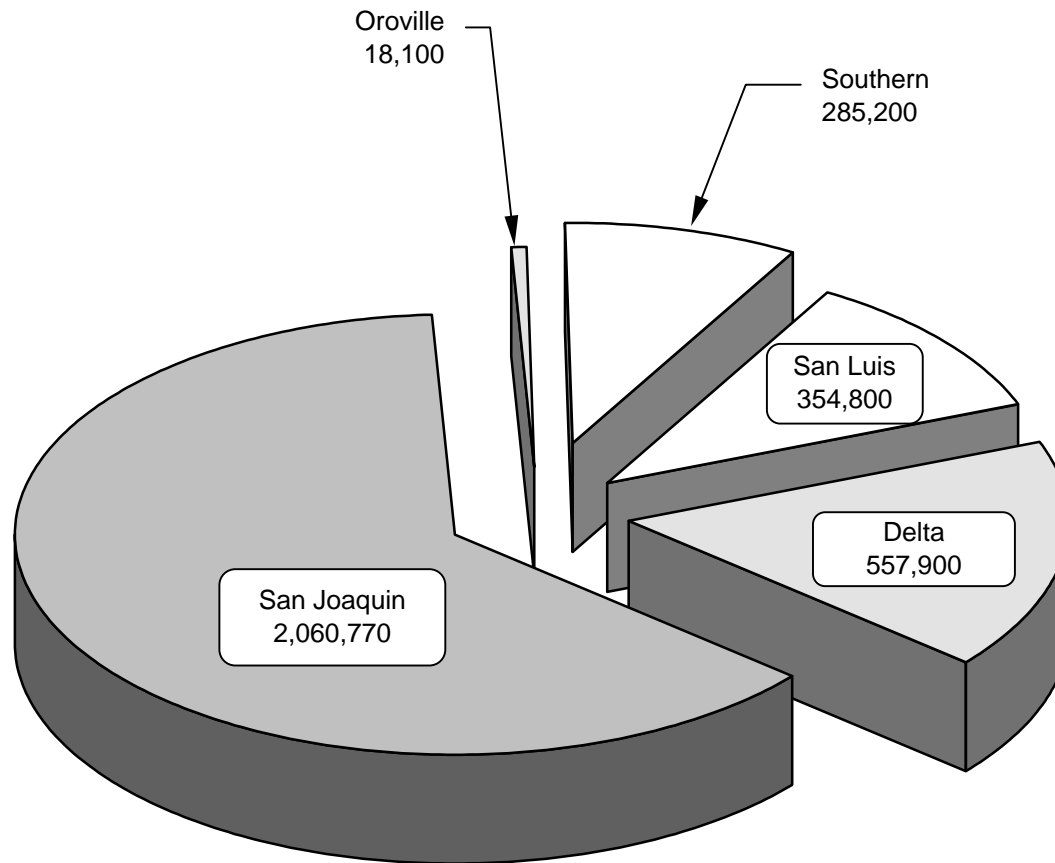
3/ Station Service only.

Total State: 10,345,060

Total Federal: 406,960

Total Loads: 10,752,020

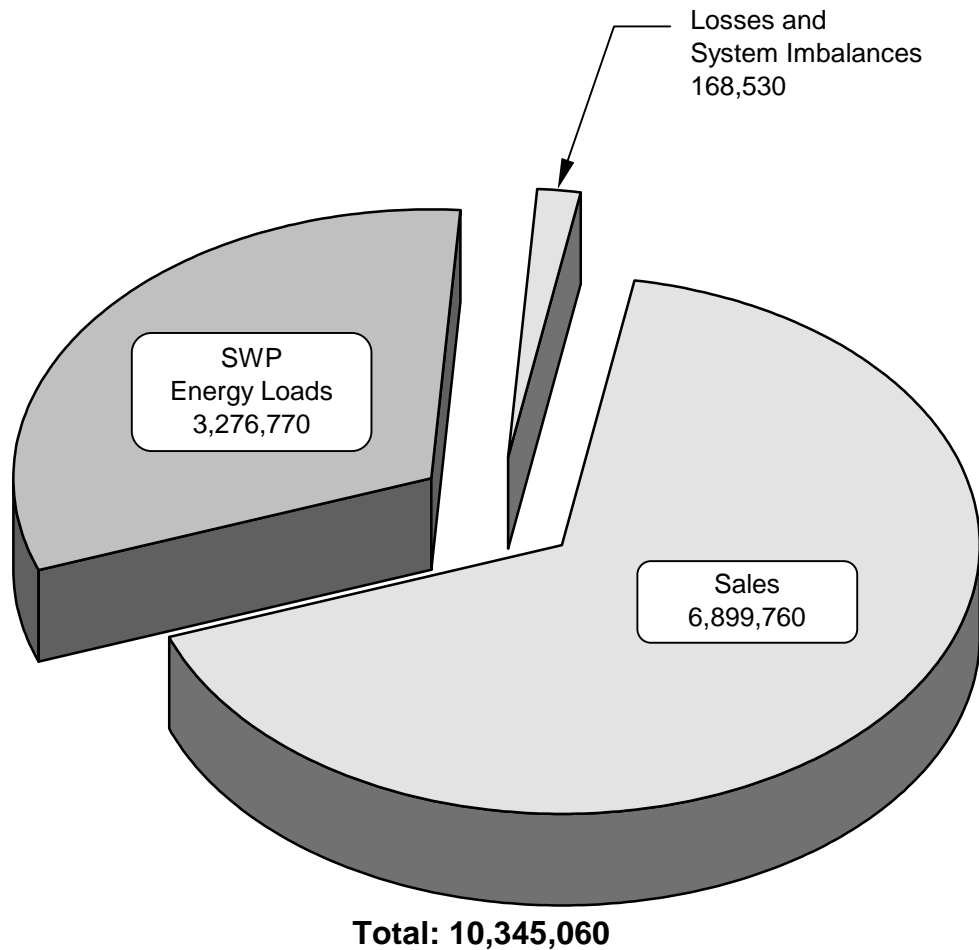
**Figure 5. SWP Energy Loads**  
**1998**  
(all values in MWh)



**Total: 3,276,770**

<u>Oroville Field Division</u>	
Hyatt-Thermalito Complex (Pumpback and Station Service)	18,100
	<hr/> 18,100
<u>Delta Field Division</u>	
North Bay	14,980
South Bay	67,630
Del Valle	100
Banks	474,720
Bottle Rock (Station Service)	470
	<hr/> 557,900
<u>San Luis Field Division</u>	
Gianelli	152,220
Dos Amigos	202,100
Pine Flat (Station Service)	480
	<hr/> 354,800
<u>San Joaquin Field Division</u>	
Las Perillas	8,610
Badger Hill	23,140
Devil's Den	15780
Bluestone	15990
Polonio	16040
Buena Vista	173,440
Teerink	166,060
Chrisman	366,220
Edmonston	1,275,490
	<hr/> 2,060,770
<u>Southern Field Division</u>	
Oso	36,520
Mojave (Station Service)	470
Devil Canyon (Station Service)	2,200
Alamo (Station Service)	370
Pearblossom	243,310
Warne (Station Service)	2,330
	<hr/> 285,200

**Figure 6. Total State Energy Loads**  
**1998**  
(all values in MWh)



Note: See Figure 5 for breakdown of SWP Energy Loads.

Sales

New Energy Ventures, Inc. L.L.C.	790,867
PacifiCorp Power Marketing	648,778
Nevada Power Company	599,976
Sacramento Munic. Util. Dist.	582,472
Enron Power Marketing	448,680
Duke Energy Trading and Marketing	414,412
California Power Exchange	398,791
Northern California Power Agency	325,936
City of Glendale	292,129
Salt River Project	197,279
City of Vernon	191,534
City & County of San Francisco	183,661
L.A. Dept. of Water and Power	180,944
California Independent Systems Oper	177,560
Southern California Edison	148,618
City of Azusa Light and Power Dept.	141,438
Arizona Public Services Company	140,419
City of Riverside	117,188
Modesto Irrigation District	102,531
Pacific Gas & Electric Company	88,248
San Diego Gas & Electric Company	80,815
City of Burbank	77,082
Sempra Energy Trading Corp.	76,575
City of Redding	63,274
Portland General Electric	62,730
Puget Sound Energy, Inc.	52,271
British Columbia Power Exch. Corp.	52,113
Anaheim Public Utilities Department	37,680
New West Energy	36,000
PG&E Energy Trading	25,600
City of Pasadena	24,334
City of Banning	22,120
Citizen's Power Sales	20,800
Western Area Power Admin.	19,240
City of Colton	14,897
City of Santa Clara	10,910
Seattle City Light	10,171
Metropolitan Water Dist. Of So. Cal	8,655
Washington Water Power	7,920
Electric Clearinghouse, Inc.	7,716
Illinova Power Marketing Inc.	5,282
Avista Energy Inc.	2,400
Lassen Municipal Utility District	2,323
Bonneville Power Administration	1,900
PG&E Energy Service	1,600
QST Energy Trading Inc.	800
Williams Energy Services Co.	680
NorAm Energy Services, Inc.	610
So. Energy Trading and Marketing	600
LG&E Power Marketing, Inc.	289
Snohomish Co. Pub. Util. Dist.	234
Koch Energy Trading	225
Associated Bay Area Governments	221
Idaho Power Company	120
Destech West	112
	<hr/>
	6,899,760

## ***Sacramento - San Joaquin Delta Operations***

The Sacramento-San Joaquin Delta provides an estimated one-half of the State's water supply. In addition, the Delta is an estuary, a constantly changing area where tidal and river currents meet, and where salinity is between the extremes of brackish and fresh waters. The estuary provides habitat for fish and wildlife, including waterfowl on the Pacific Flyway.

Many of the problems facing the Delta today, such as saltwater intrusion and oxidation of peat soil, have plagued the area for many years. Originally a tidal marshland covered with tules, the Delta, during dry summer months, has been subject to intrusions of salty ocean water from the San Francisco Bay.

Today, dams upstream of the Delta, including SWP's Oroville Dam and CVP's Shasta Dam, help control the intrusion of salt water by releasing fresh water into the Delta during dry periods in summertime. However, problems with salinity in the Delta still exist

With assistance from urban, agricultural, and environmental interests, and other stakeholders concerned with Bay-Delta issues, State and federal agencies developed the Bay Delta Accord. The Accord grew out of Governor Wilson's 1992 policy to "fix the Delta." This led to events that shaped the State-Federal Framework Agreement, signed in June 1994, and the Bay-Delta Accord signed December 15, 1994. *Bulletin 132-95, Chapter 1*, explains both the State-Federal Framework Agreement and the Bay-Delta Accord in detail.

### ***Net Delta Outflow Index***

Delta outflow is not measured directly due to the major tidal influence in the Delta. Instead an index of Delta outflow is calculated using measured inflows, exports, and estimated in-Delta water use. A new

method of calculating Delta outflow was introduced in the 1995 Principles for Agreement on Bay-Delta Standards. This new index, the Net Delta Outflow Index, considers inflows of the Yolo Bypass system, the eastside stream system (the Mokelumne, Cosumnes, and Calaveras rivers), San Joaquin River at Vernalis, and Sacramento Regional Wastewater Treatment Plant. Major Delta exports and the estimated in-Delta water use are deducted from the cumulative inflow total to produce the index. The NDOI became effective for use in Delta standards compliance on January 1, 1995. Table 5 shows the computed daily NDOI for 1998.

The NDOI calculated flows cannot be directly compared to the prior Delta Outflow Index, as the Sacramento River bypass flows and several eastside stream flows were not included in the earlier DOI calculations. Those flows can be quite substantial during high flow periods. In 1998, the Yolo Bypass flows contributed 22 percent of total Delta inflow and, during the extremely high flow events of March, contributed over 60 percent of inflow. A comparison of Delta Inflow and NDOI is plotted on Figure 7. Gross channel depletion is the sum of evapotranspiration and net increase in soil moisture of Delta lands plus evaporation from Delta channels.

The 1998 daily NDOI averaged 67,243 cfs for the year and was 24,444 cfs more than the 1997 daily average. The greatest mean monthly NDOI occurred in February at 244,789 cfs and the greatest mean daily was 320,363 cfs on February 8. The lowest monthly NDOI occurred in October (12,264 cfs) and the year's lowest daily NDOI was on October 23 with 7,760 cfs.

D-1485 standards set a minimum NDOI at Chipps Island for adequate water for fisheries. All NDOI and river flow standards were met in 1998.

**Table 5. Net Delta Outflow Index  
1998**

(in cfs-days except as noted)

Date	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	3,915	138,466	186,585	150,933	64,647	89,697	12,033	21,213	20,424	17,981	8,610	43,321
2	3,965	138,094	173,960	133,626	63,417	120,761	48,670	18,301	21,885	17,990	8,858	45,902
3	5,730	154,478	161,113	120,311	67,029	115,740	46,340	20,584	20,440	17,185	10,036	47,691
4	7,554	231,281	152,722	122,511	68,866	103,067	44,370	20,040	20,346	15,322	10,310	54,644
5	15,325	268,718	145,574	122,659	69,527	92,293	42,725	20,820	21,309	15,163	9,545	59,439
6	21,552	292,413	136,902	114,746	71,207	85,282	41,008	22,286	21,552	14,751	9,664	61,058
7	24,167	310,363	129,352	110,277	71,749	82,380	42,037	20,657	22,388	13,856	8,855	63,915
8	20,683	320,363	120,086	106,945	70,090	79,770	43,593	19,999	23,781	13,166	10,021	66,071
9	17,831	314,667	109,700	104,246	69,009	77,237	40,970	18,544	23,998	12,912	13,834	65,927
10	17,350	315,877	101,373	103,285	66,728	75,917	38,062	21,053	23,622	12,613	14,634	64,933
11	19,154	302,747	92,477	98,546	62,780	73,423	37,293	20,943	22,713	11,320	14,721	62,231
12	21,028	279,469	87,840	94,672	60,982	71,092	37,514	21,756	22,398	11,434	15,845	61,021
13	43,470	258,202	84,179	92,160	64,256	69,442	40,486	20,535	19,984	11,145	13,570	59,306
14	67,353	244,312	80,681	94,225	68,005	69,262	39,236	20,135	21,013	10,739	14,073	57,718
15	72,828	248,684	77,218	94,212	70,803	69,578	34,249	20,571	20,998	9,655	15,175	56,269
16	89,559	258,492	74,477	92,984	70,614	71,379	32,009	18,441	19,061	9,803	16,786	55,035
17	132,879	253,549	72,857	88,402	69,534	73,069	30,043	19,947	20,105	9,491	18,300	52,108
18	144,405	244,002	70,775	83,782	67,008	73,659	30,520	19,594	19,292	8,647	19,547	48,307
19	156,806	229,921	67,540	78,234	67,287	71,861	28,481	19,949	18,384	9,186	19,687	46,020
20	163,278	234,485	66,404	73,644	68,196	69,417	27,487	20,597	18,000	8,660	20,000	44,036
21	157,924	225,670	68,513	70,495	67,413	64,793	25,773	21,276	19,017	8,413	22,762	41,383
22	153,907	226,939	70,471	68,517	62,898	62,843	26,726	21,942	18,971	7,882	23,459	40,827
23	142,976	242,736	73,486	65,990	60,698	61,311	25,580	20,062	17,979	7,760	25,356	36,709
24	125,438	246,999	84,104	64,881	57,749	61,528	24,943	21,038	18,869	8,135	31,114	34,383
25	115,818	235,781	101,411	65,830	55,990	59,481	24,465	20,908	17,673	12,295	35,344	32,401
26	107,736	225,126	145,305	66,601	56,302	56,071	21,771	21,006	16,762	14,595	37,249	30,809
27	101,945	212,274	162,557	67,626	57,676	53,772	23,656	21,015	17,264	14,879	39,759	26,643
28	101,629	199,997	172,911	66,646	59,997	52,491	23,732	21,538	16,826	15,657	40,832	26,137
29	107,764		172,250	66,680	70,538	51,771	22,482	20,539	17,522	16,544	36,094	25,196
30	126,621		167,169	65,397	77,723	51,361	22,494	18,051	15,878	11,567	38,649	24,628
31	139,622		157,852		81,390		21,298	19,727		11,429		23,949
Total	2,430,212	6,854,105	3,567,844	2,749,063	2,060,108	2,209,748	1,000,046	633,067	598,454	380,175	602,689	1,458,017
Ave.	78,394	244,789	115,092	91,635	66,455	73,658	32,260	20,422	19,948	12,264	20,090	47,033
Max.	163,278	320,363	186,585	150,933	81,390	120,761	48,670	22,286	23,998	17,990	40,832	66,071
Min.	3,915	138,094	66,404	64,881	55,990	51,361	12,033	18,051	15,878	7,760	8,610	23,949
Total In AF	4,820,326	13,595,117	7,076,819	5,442,623	4,086,224	4,383,035	1,983,591	1,255,688	1,187,034	754,077	1,195,434	2,891,977

Annual Total = 48,671,944 acre-feet

**Table 6. Sacramento Basin and Sacramento-San Joaquin Delta Operations  
1998**

(in thousands of acre-feet except as noted)

Month	Upstream Reservoir Releases to River			Sacramento River Accretions or Depletions 2/	Delta Inflow				Net Delta Consumptive Use	Delta Exports					Net Delta Outflow Index
	Keswick 1/	Oroville 1/	Nimbus 1/		Sacramento River at Freeport 3/	Miscellaneous Inflows 4/	San Joaquin River at Vernalis	Total Inflow 1/		Clifton Court Forebay Intake	Barker Slough Pumping Plant	Tracy Pumping Plant	Contra Costa Pumping Plant	Total Exports	
Jan	712	317	351	3,022	3,089	1,669	331	5,089	-179	197	1	243	6	447	4,821
Feb	1,743	690	709	7,092	4,526	7,353	1,514	13,393	-386	13	2	164	4	184	13,595
Mar	1,127	596	420	2,602	3,941	2,020	1,209	7,170	-41	0	2	127	6	135	7,076
Apr	571	464	468	1,949	3,493	766	1,306	5,565	19	1	2	86	14	103	5,443
May	687	434	577	1,086	2,945	303	1,097	4,345	41	56	2	143	17	218	4,086
Jun	781	470	457	1,558	3,372	456	1,071	4,899	194	130	3	170	18	321	4,384
Jul	762	299	267	74	1,611	248	882	2,741	261	220	6	250	22	497	1,983
Aug	761	297	246	44	1,551	159	344	2,054	226	273	7	269	24	572	1,256
Sep	566	303	239	219	1,523	49	317	1,889	151	266	5	259	20	551	1,188
Oct	353	156	138	211	1,004	37	352	1,393	64	297	2	256	20	575	754
Nov	497	77	162	378	1,217	32	219	1,468	-2	130	2	127	16	275	1,195
Dec	821	588	186	989	2,768	70	252	3,090	54	127	3	2	12	144	2,892
Total	9,379	4,690	4,219	19,224	31,039	13,162	8,894	53,095	402	1,710	37	2,095	178	4,021	48,672

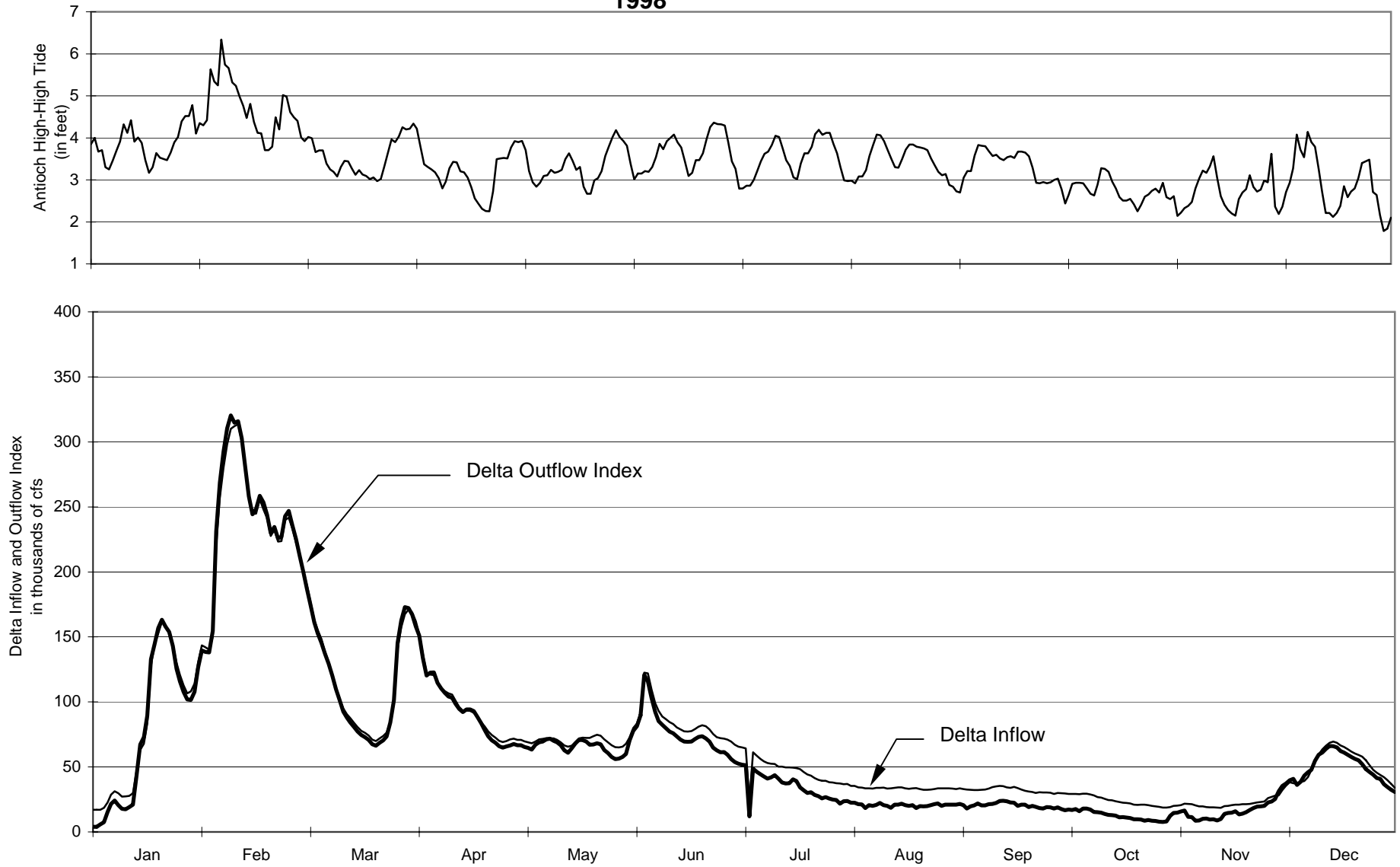
1/ Time lagged values (Keswick: 5 days; Oroville: 3 days; Nimbus and Total Inflow: 1 day).

2/ Positive values are accretions; negative values are depletions.

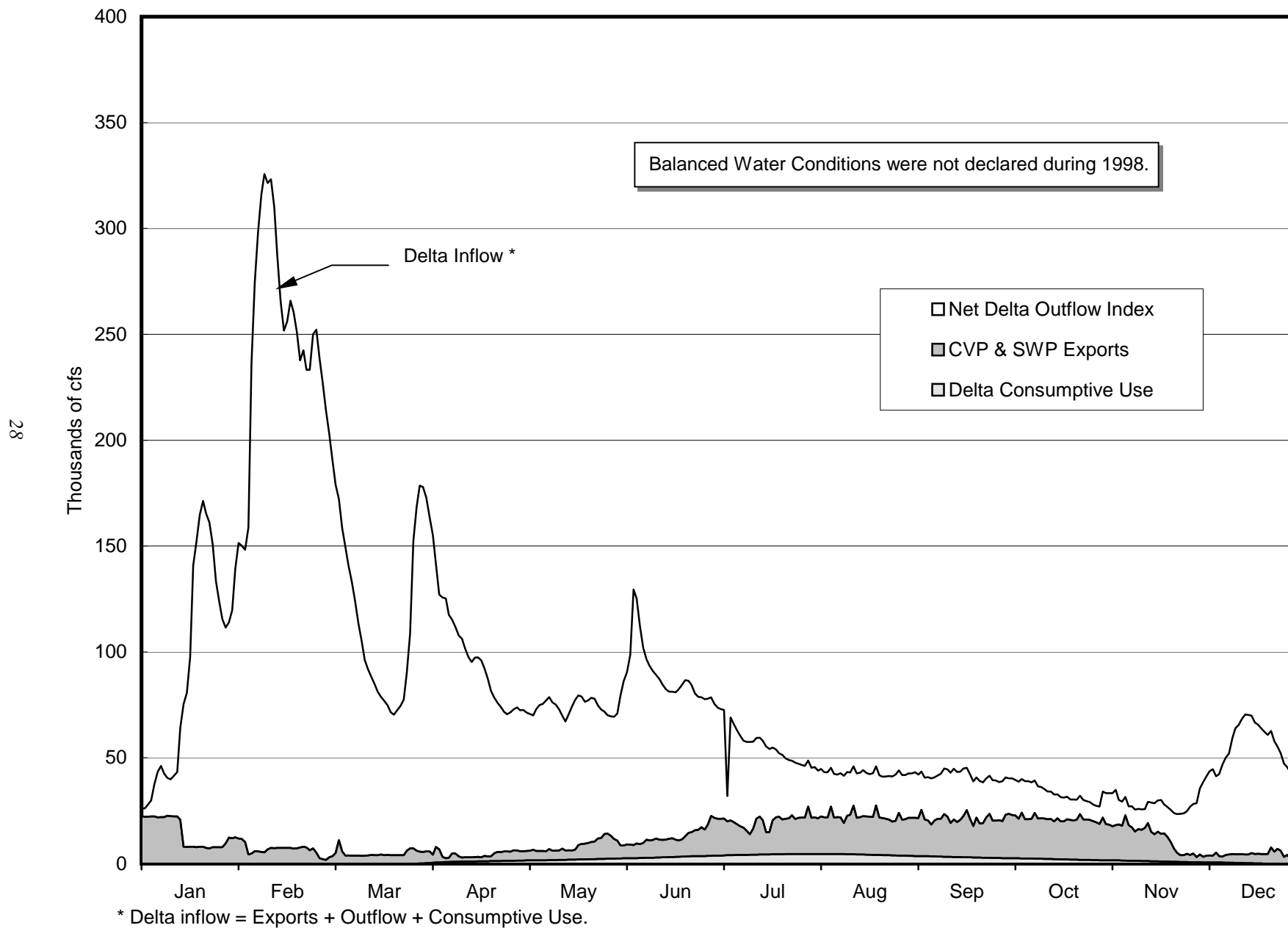
3/ These values are based on a measured daily average taken from the Sacramento River at Freeport and include Sacramento County Regional Waste Treatment Plant.

4/ Includes Yolo Bypass, Eastside Streams, and Miscellaneous Inflows.

**Figure 7. Delta Tide, Inflow, and Outflow Index  
1998**

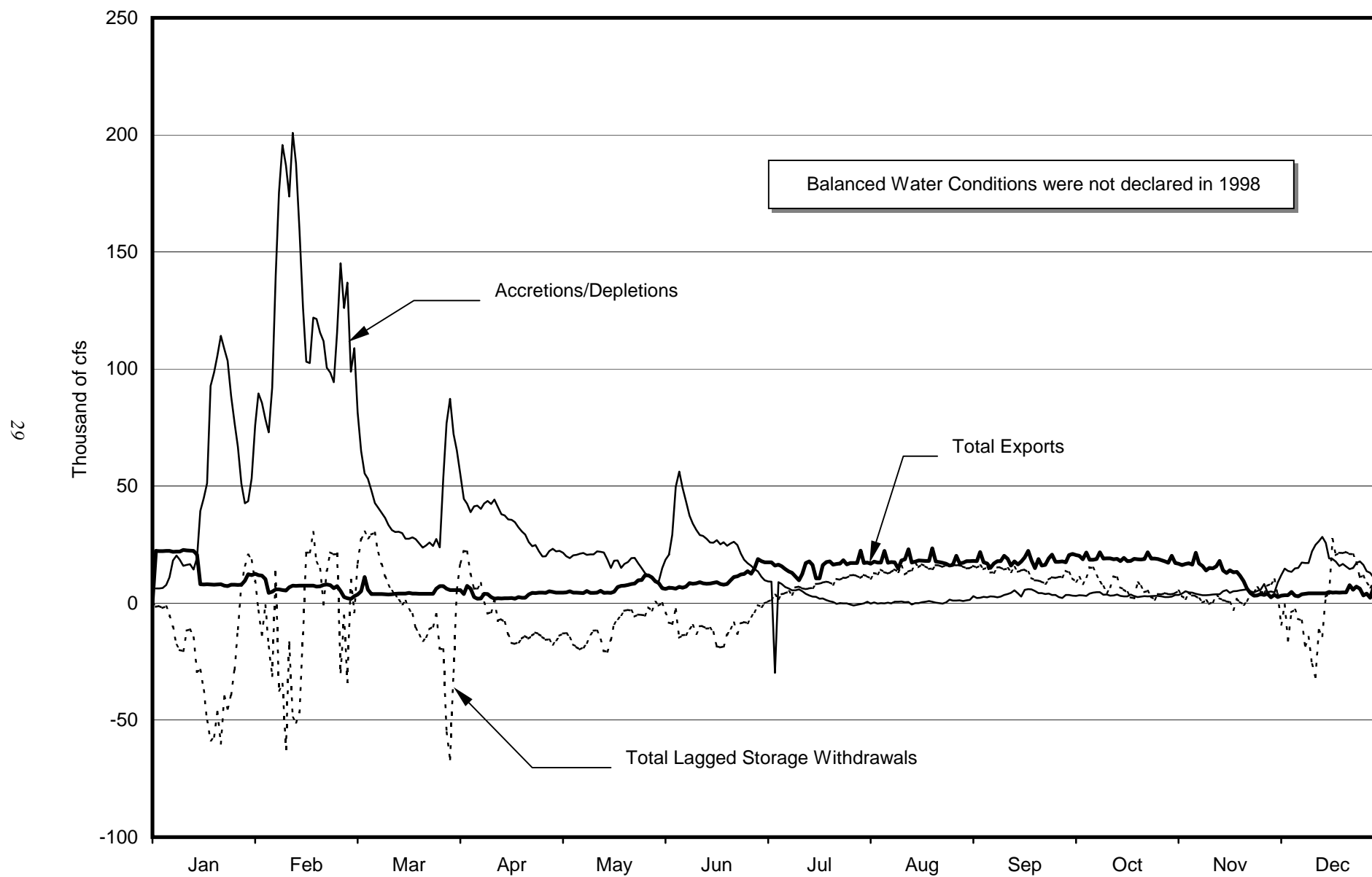


**Figure 8. Coordinated Delta Operations  
1998**

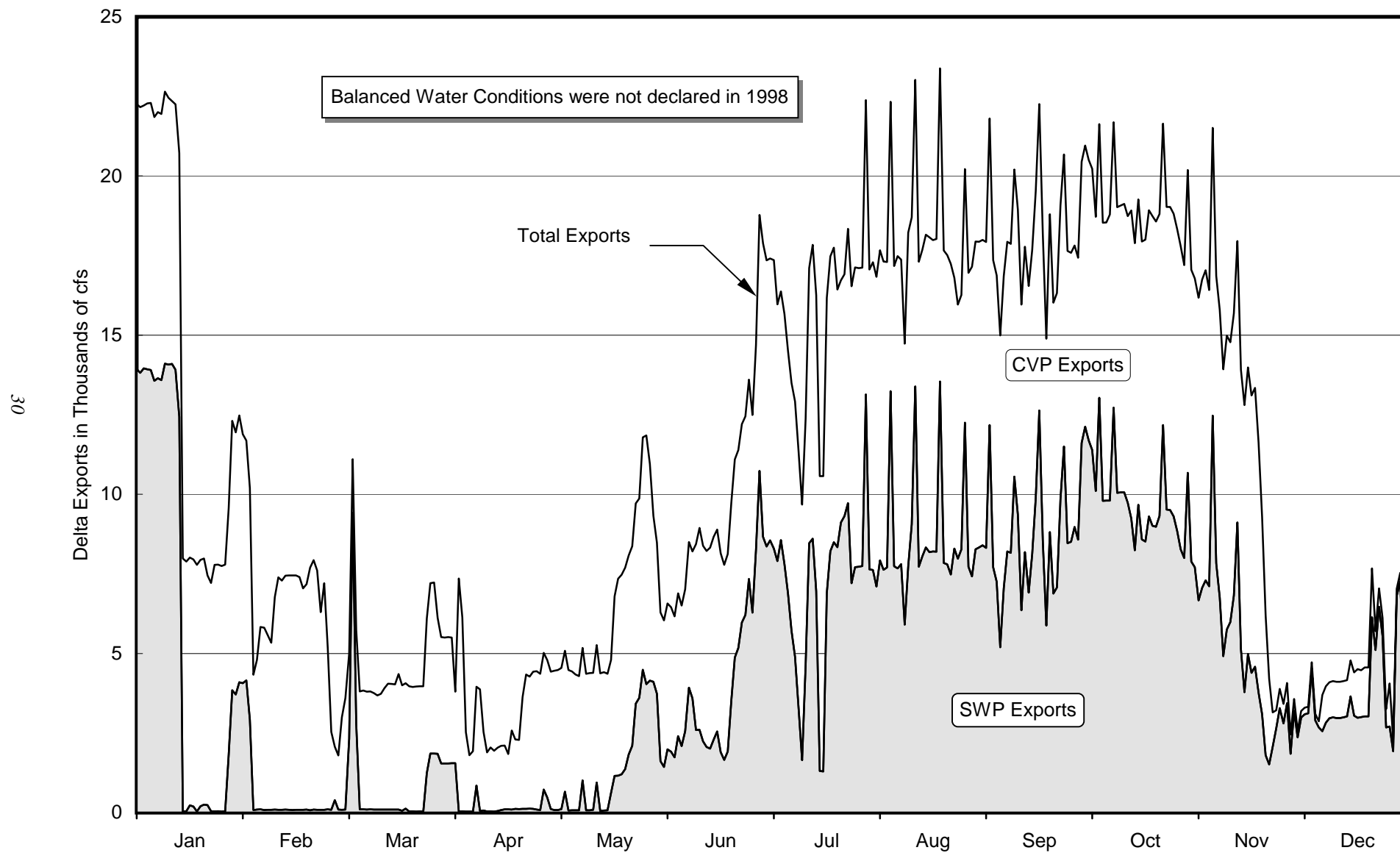




**Figure 9. Coordinated Delta Operations  
Lagged Storage Withdrawals  
1998**



**Figure 10. Coordinated Delta Operations**  
**Delta Exports**  
**1998**



## *Project Operations by Field Division*

### *Oroville Field Division*

#### **Water Storage**

SWP water storage facilities in the Oroville Field Division include Lake Oroville, Thermalito Forebay and Afterbay (Oroville-Thermalito Complex) and upper Feather River reservoirs consisting of Lake Davis, Frenchman Lake, and Antelope Lake. Lake Oroville operations store winter and spring runoff for later SWP use for power generation, flood control, recreation, fish and wildlife enhancement, in addition to water supply.

The Upper Feather River Reservoirs have a combined capacity of 162,000 AF. Monthly operations for the three Upper Feather River reservoirs are presented in Table 7. The table below compares storage capacity with the largest end-of-month storage for each reservoir for the last five years:

Year	Reservoir (Capacity)		
	Antelope 22,566	Frenchman 55,477	Davis 84,371
1998	(Apr) 24,030	(Apr) 56,989	(Jun) 74,142
1997	(Jan) 27,696	(Jan) 58,350	(Jan) 83,929
1996	(Dec) 23,944	(Mar) 57,881	(May) 81,858
1995	(Apr) 25,242	(Apr) 58,172	(May) 84,331
1994	(May) 19,686	(Mar) 32,770	(Apr) 63,089

The total amount of unimpaired runoff to Lake Oroville for the 1997-98 water year totaled about 6.69 MAF, (150 percent of average). Lake Oroville storage at the beginning of 1998 was 2,231,018 AF (63 percent of normal maximum operating capacity). Storage peaked on June 28, 1998 at 3,525,895 AF, (99 percent of normal maximum operating capacity). Lowest storage in Lake Oroville in 1998 was 2,231,018 (63 percent of normal maximum operating capacity) on January 1. By December 31, 1998, storage was at 2,687,877 (76 percent of normal maximum operating capacity).

Lake Oroville's computed inflow is tabulated in Table 8 and plotted along with releases, diversions, and storage withdrawals on Figure 11. A ten-year historical summary of Lake Oroville's storage and inflow is illustrated on Figure 12.

Water temperatures on and below the lake's surface are monitored very closely throughout the year at

various locations around the lake. Two intakes to the powerplant have shutters that control the depth from which water enters the plant. The temperature of water entering the fish hatchery can then be controlled by adding or removing shutters as necessary. A complete illustration of water temperature and intake operation is shown on Figure 14. Further discussions on water temperature operations are detailed in "Water Deliveries and Aqueduct Operations."

#### **Water Deliveries**

Project water stored in the Upper Feather Area lakes flows into Lake Oroville through the North and Middle Forks of the Feather River. Contract deliveries totaled 1,582 AF to two agencies. Non-project deliveries (prior water rights) totaling 10,046 AF were made out of Frenchman Lake and 469 AF out of Lake Davis.

Water stored in Lake Oroville is released into the Thermalito Diversion Dam Pool, from which specified quantities are released into both the Feather River and the Thermalito Power Canal. The power canal supplies water first to the Thermalito Forebay and then to Thermalito Afterbay. From the Thermalito Afterbay, additional water is released to the Feather River and several local distribution systems used to deliver water to prior water right holders. These deliveries are collectively called the Feather River Service Area diversions. FRSA diversions are not considered SWP benefits, as they predate the SWP construction, and would have occurred in the absence of the SWP to the limit of available natural river flows. Nearly all FRSA diversions are for agricultural use and totaled 860,421 AF in 1998, about 119 TAF less than in 1997. All FRSA diversions are detailed below:

Sutter Butte Canal	458,290
Richvale Canal	127,813
Sunset Pumps	1,559
Western Canal Lateral	3,547
Western Canal	238,250
Tudor Mutual	2,112
Garden Highway	13,685
Plumas Mutual	7,841
Oswald Water District	851
Palermo Canal	6,473
Total in AF	860,421

**Table 7. Upper Feather Area Lakes Monthly Operation**

**1998**

(in acre-feet except as noted)

Month	Lake Storage			Outflow							Inflow
	Water Surface Elevation (in feet)	End of Month Storage	Storage Change	Regulated Release				Spill	Estimated Evaporation and Seepage	Total Outflow	Computed
				Stream-Flow Maint.	Water Supply Contract	Prior Water Rights	Total Regulated Release				

**Antelope Lake Capacity 22,566 acre-feet**

Jan	4998.14	19,132	1,608	1,349	0	0	1,349	0	58	1,407	3,015
Feb	4995.87	17,268	-1,864	3,721	0	0	3,721	0	66	3,787	1,923
Mar	4999.99	20,736	3,468	4,147	0	0	4,147	0	101	4,248	7,716
Apr	5003.55	24,030	3,294	4,090	0	0	4,090	2,293	182	6,565	9,859
May	5003.09	23,589	-441	1,230	0	0	1,230	14,245	306	15,781	15,340
Jun	5002.51	23,041	-548	1,190	0	0	1,190	9,031	428	10,649	10,101
Jul	5001.88	22,453	-588	1,230	0	0	1,230	976	698	2,904	2,316
Aug	5000.40	21,108	-1,345	1,230	0	0	1,230	0	726	1,956	611
Sep	4999.06	19,920	-1,188	1,190	0	0	1,190	0	397	1,587	399
Oct	4997.81	18,854	-1,066	1,230	0	0	1,230	0	255	1,485	419
Nov	4998.18	19,166	312	1,190	0	0	1,190	0	133	1,323	1,635
Dec	4998.84	19,730	564	1,230	0	0	1,230	0	95	1,325	1,889
Total	---	---	2,206	23,026	0	0	23,026	26,546	3,445	53,017	55,223

**Frenchman Lake Capacity 55,477 acre-feet**

Jan	5578.75	42,030	1,175	184	0	0	184	0	92	276	1,451
Feb	5579.82	43,471	1,441	167	0	0	167	0	93	260	1,701
Mar	5585.31	51,329	7,858	184	0	0	184	0	170	354	8,212
Apr	5588.89	56,894	5,565	179	0	0	179	766	310	1,254	6,819
May	5588.54	56,334	-560	184	0	0	184	7,075	529	7,789	7,229
Jun	5588.33	56,000	-334	179	0	0	179	4,451	719	5,348	5,014
Jul	5586.18	52,648	-3,352	10	0	3,027	3,037	220	1,173	4,430	1,078
Aug	5582.41	47,081	-5,567	0	0	4,687	4,687	0	1,183	5,870	303
Sep	5581.32	45,540	-1,541	0	0	1,525	1,525	0	646	2,171	630
Oct	5580.96	45,038	-502	0	0	559	559	0	390	949	447
Nov	5581.44	45,708	670	54	0	248	301	0	223	524	1,194
Dec	5582.04	46,554	846	123	0	0	123	0	155	278	1,124
Total	---	---	5,699	1,263	0	10,046	11,310	12,512	5,683	29,505	35,204

**Lake Davis Capacity 84,371 acre-feet**

Jan	5765.68	51,337	2,557	615	0	0	615	0	208	823	3,380
Feb	5766.69	54,472	3,135	555	0	0	555	0	217	772	3,907
Mar	5769.09	62,369	7,897	1,934	0	0	1,934	0	394	2,328	10,225
Apr	5770.53	67,400	5,031	3,943	0	0	3,943	0	699	4,642	9,673
May	5771.81	72,127	4,727	4,296	0	0	4,296	0	1,197	5,493	10,220
Jun	5772.37	74,142	2,015	1,439	0	5	1,444	0	1,678	3,122	5,137
Jul	5771.56	71,131	-3,011	1,293	0	65	1,359	0	2,782	4,141	1,130
Aug	5770.63	67,757	-3,374	1,213	0	201	1,414	0	2,352	3,766	392
Sep	5770.05	65,699	-2,058	1,101	0	198	1,299	0	1,595	2,894	836
Oct	5769.37	63,330	-2,369	1,414	0	0	1,414	0	978	2,392	23
Nov	5769.74	64,613	1,283	1,369	0	0	1,369	0	554	1,923	3,206
Dec	5769.84	64,962	349	1,414	0	0	1,414	0	384	1,798	2,147
Total	---	---	16,182	20,587	0	469	21,057	0	13,038	34,095	50,277

**Table 8. Lake Oroville Monthly Operation  
1998**

(in acre-feet except as noted)

Capacity 3,537,577 acre-feet

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Outflow					Hyatt Pumpback	Computed Inflow 2/
				Hyatt Generation 1/	Palermo Canal	Evaporation	Spill and Leakage	Total Outflow		
Jan	838.34	2,654,963	430,791	408,057	104	799	472	409,432	17,274	822,949
Feb	842.87	2,713,849	58,886	754,173	5	1,157	207,960	963,295	1,496	1,020,685
Mar	850.30	2,812,374	98,525	673,826	52	2,537	119,322	795,737	0	894,262
Apr	865.78	3,025,675	213,301	512,804	145	3,624	1,626	518,199	0	731,500
May	884.72	3,301,917	276,242	587,812	398	3,749	2,824	594,783	0	871,025
Jun	898.60	3,515,500	213,583	641,233	681	6,957	57	648,928	0	862,511
Jul	887.27	3,340,440	-175,060	519,496	1,182	11,473	0	532,151	0	357,091
Aug	868.14	3,059,166	-281,274	502,748	1,240	12,054	0	516,042	0	234,768
Sep	851.72	2,831,485	-227,681	418,626	1,200	8,249	0	428,075	0	200,394
Oct	843.48	2,721,845	-109,640	257,054	990	5,945	140	264,129	0	154,489
Nov	856.02	2,889,913	168,068	166,142	350	1,706	0	168,198	0	336,266
Dec	840.88	2,687,876	-202,037	652,033	167	1,442	26,156	679,798	0	477,761
Total	---	---	463,704	6,094,004	6,514	59,692	358,557	6,518,767	18,770	6,963,701

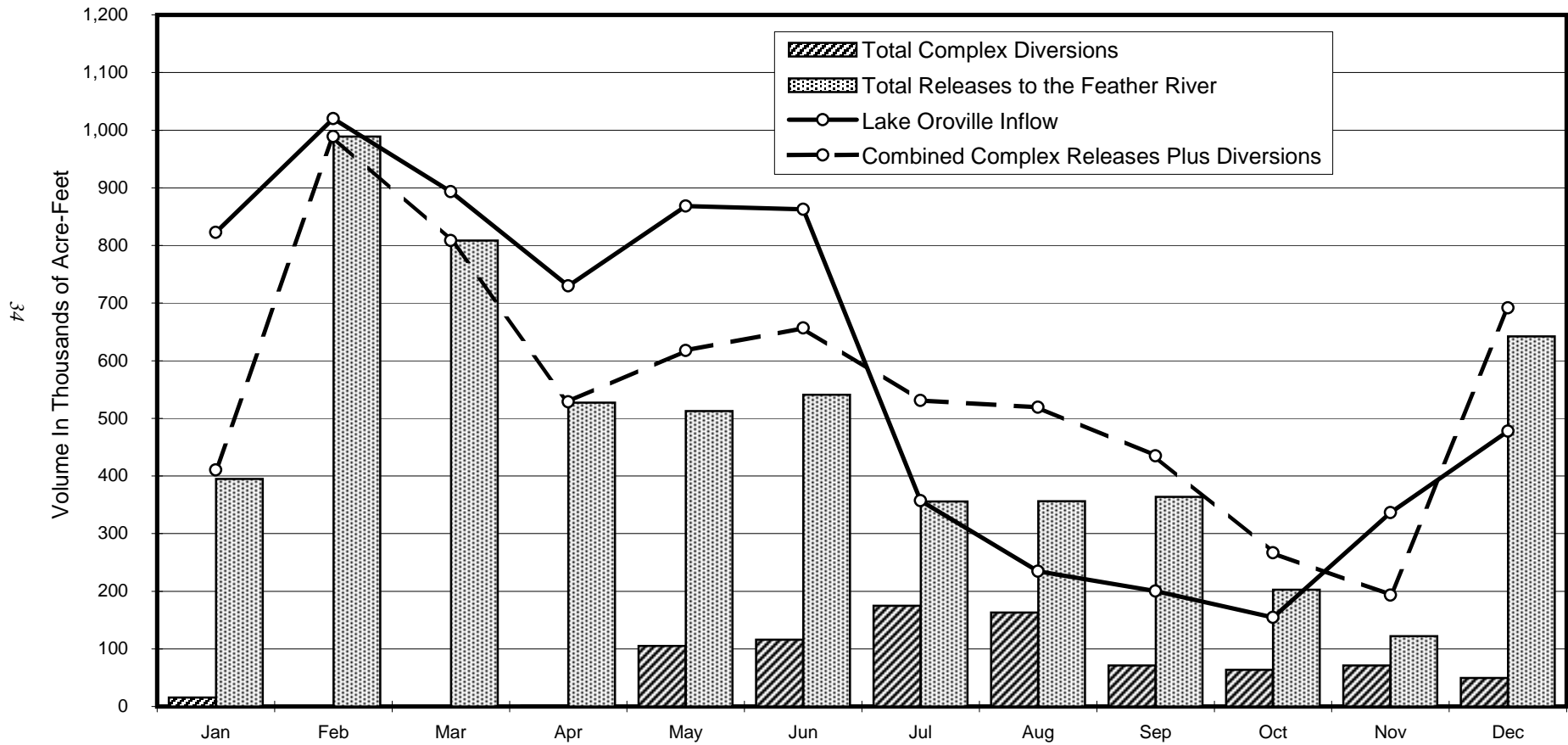
1/ Includes bypass flows.

2/ Does not include pumpback.

**Figure 11. Oroville-Thermalito Complex**

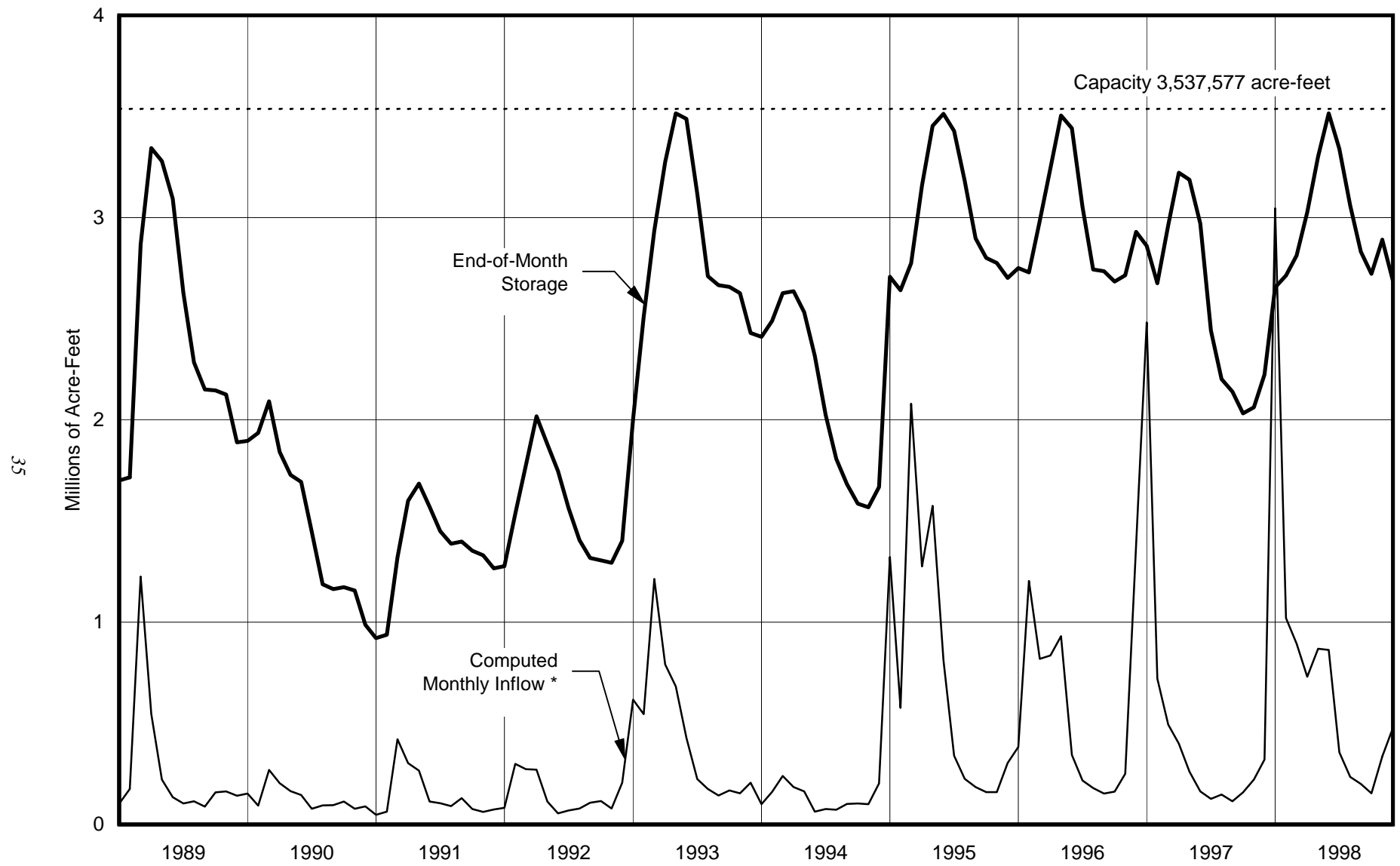
Inflow, Releases, and Diversions

**1998**



Note: Releases include flows at fish barrier dam, fish hatchery, and afterbay river outlet. Diversions include Butte County, Thermalito Irrigation District, Sutter Butte Canal, Western Lateral, Richvale Canal, Sunset Pumps, and Western Canal. The area between the plotted lines above the Inflow line represents amounts derived from storage.

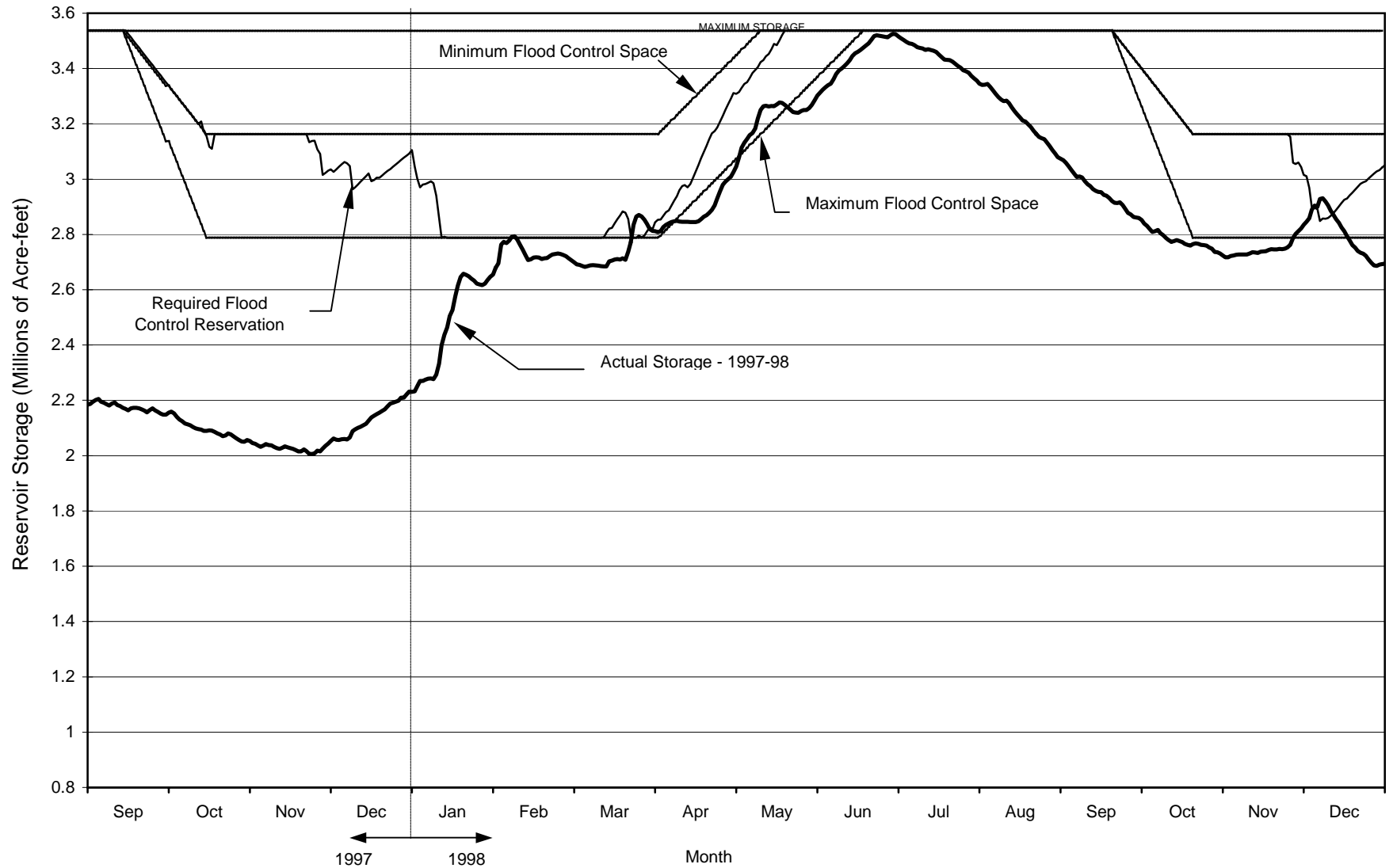
Figure 12. Historical Lake Oroville Operation



\* Excludes pumpback.

Figure 13. Operation of Lake Oroville for Flood Control

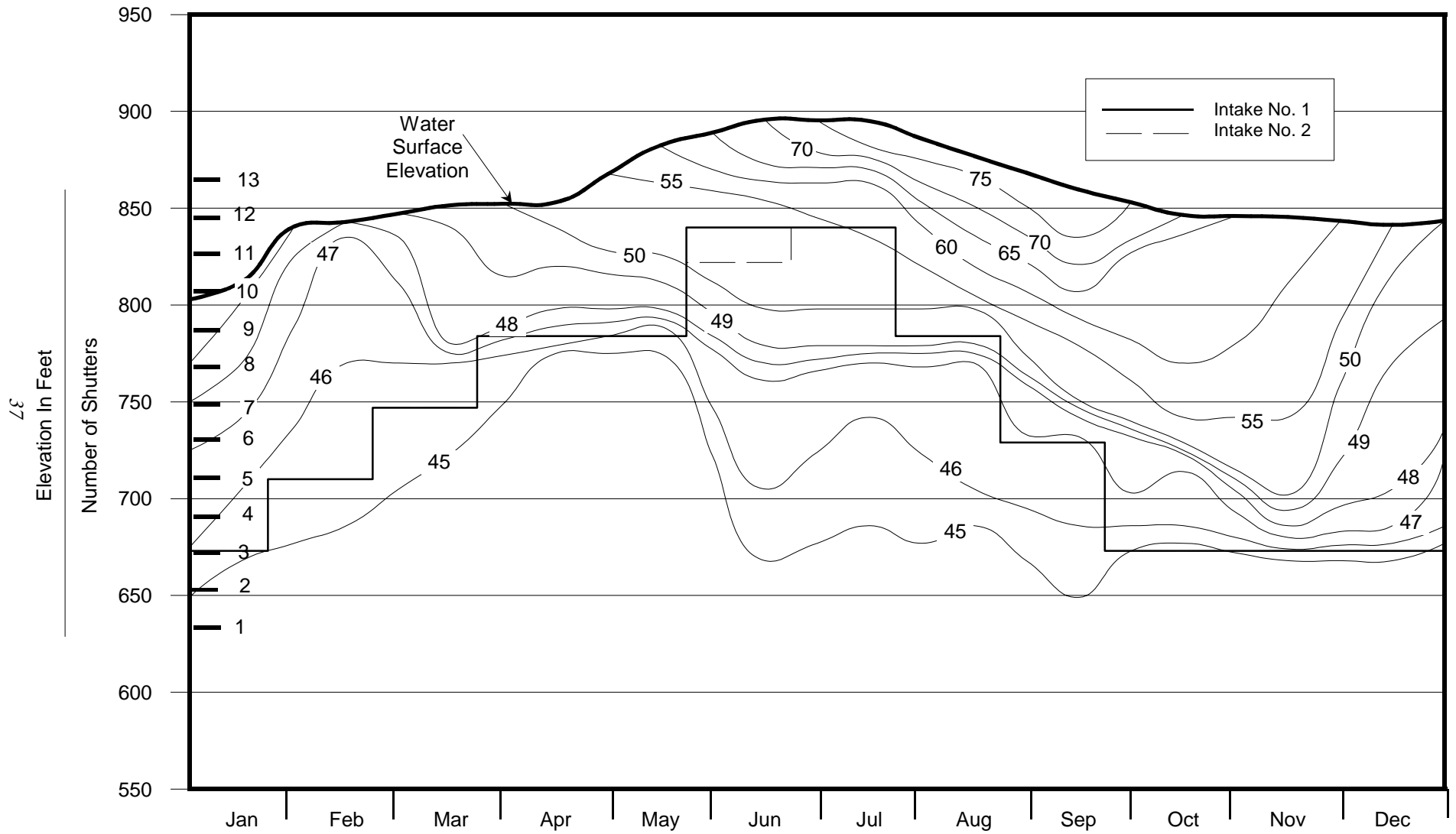
1997-98





**Figure 14. Lake Oroville Temperatures  
1998**

( isotherms in degrees Farenheit )



Note: Temperature data is taken once per month and averaged for the rest of the year.

**Table 9. Thermalito Forebay Monthly Operation  
1998**

Including Diversion Pool and Power Canal  
(end of month storage in acre-feet)

Month	Storage 2/	Storage Change	Inflow			Outflow					Losses (-) And Gains (+)
			Lake Oroville Releases 2/	Kelly Ridge Generation	Thermalito Pumpback	Thermalito Generation 3/	Butte County	Thermalito Irrigation District	Releases To River 4/	Hyatt Powerplant Pumpback	
Jan	23,176	-2,118	408,529	15,680	28,149	391,470	86	89	58,750	17,274	13,193
Feb	23,415	239	962,133	14,140	3,233	746,845	44	86	242,015	1,496	11,220
Mar	23,737	322	793,148	15,550	0	664,060	103	98	150,545	0	6,430
Apr	23,601	-136	514,430	15,010	0	500,148	42	32	37,556	0	8,202
May	22,244	-1,357	590,636	15,730	0	576,329	129	124	38,396	0	7,255
Jun	21,681	-563	641,290	14,960	0	633,926	11	219	37,786	0	15,129
Jul	23,255	1,574	519,496	15,294	0	506,634	1	413	38,440	0	12,272
Aug	22,991	-264	502,748	15,330	0	486,786	49	416	38,103	0	7,012
Sep	23,192	201	418,626	13,413	0	399,919	3	298	37,786	0	6,168
Oct	23,799	607	257,194	9,430	0	233,395	1	204	38,778	0	6,361
Nov	23,675	-124	166,142	15,140	0	149,732	75	105	37,904	0	6,410
Dec	22,871	-804	678,189	15,370	0	663,926	32	109	38,460	0	8,164
Total	- - -	-2,423	6,452,561	175,046	31,382	5,953,170	576	2,193	794,519	18,770	107,815

1/ Sum of Thermalito Forebay and Diversion Pool.

2/ Sum of releases from Lake Oroville through Hyatt plant, spill, and spillway leakage.

3/ Includes bypass flows.

4/ Sum of Diversion Dam generation plus Hatchery.

**Table 10. Thermalito Afterbay Monthly Operation  
1998**

(end of month storage in acre-feet)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow	Outflow						Losses (-) And Gains (+)	Total Releases to River 2/
				Thermalito Generation 1/	Sutter Butte Canal	Western Canal Lateral	Richvale Canal	Western Canal	River Outlet	Thermalito Pumpback		
Jan	131.58	37,603	712	391,470	9,440	15	3,900	2,190	335,884	28,149	-11,180	394,634
Feb	130.51	33,867	-3,736	746,845	0	0	0	0	747,044	3,233	-304	989,059
Mar	131.40	36,962	3,095	664,060	0	0	0	0	657,844	0	-3,121	808,389
Apr	133.20	43,605	6,643	500,148	1,190	0	143	260	489,510	0	-2,402	527,066
May	130.72	34,586	-9,019	576,329	53,930	571	14,980	35,130	474,213	0	-6,524	512,609
Jun	132.22	39,925	5,339	633,926	70,810	500	15,630	28,740	503,079	0	-9,828	540,865
Jul	133.08	43,147	3,222	506,634	93,520	964	23,860	55,270	317,417	0	-12,381	355,857
Aug	132.04	39,266	-3,881	486,786	89,540	904	24,010	47,440	318,076	0	-10,697	356,179
Sep	130.54	33,970	-5,296	399,919	50,920	103	7,700	12,250	325,912	0	-8,330	363,698
Oct	131.14	36,045	2,075	233,395	31,420	98	7,730	24,310	163,862	0	-3,900	202,640
Nov	130.09	32,451	-3,594	149,732	31,010	331	15,750	23,970	83,988	0	1,723	121,892
Dec	129.07	29,131	-3,320	663,926	26,510	61	14,110	8,690	603,538	0	-14,337	641,998
Totals			-7,760	5,953,170	458,290	3,547	127,813	238,250	5,020,367	31,382	-81,281	5,814,886

1/ Includes bypass flows.

2/ The sum of the flows from the fish barrier dam, fish hatchery, and afterbay river outlet.

## Delta Field Division

### Water Storage

The Delta Field Division consists of the North Bay Aqueduct, the South Bay Aqueduct, and the California Aqueduct from Clifton Court Forebay to Check 12. Along these waterways, water storage operations take place at Clifton Court Forebay, Bethany Reservoir, Travis Tank, Napa Terminal Tank, the California Aqueduct, and Lake Del Valle. Changes in storage for the South Bay Aqueduct are not calculated; assumed to be zero for operational purposes, and are not factored into losses and gains.

Releases from Lake Del Valle back into the Aqueduct usually occurs in the fall and is detailed in Table 11. Inflow and storage changes for the last ten years at Lake Del Valle are shown on Figure 15.

Project water flows from the Delta into Clifton Court Forebay through the Clifton Court control gates. A schedule of daily gate operation is published in the *SWP Monthly Report of Operations*. Monthly inflows to Clifton Court Forebay along with corresponding storage changes are shown in Table 12.

### Water Deliveries

The Delta Field Division delivered 143,272 AF of water in 1998. These and other deliveries are summarized in Table 2.

The North Bay Aqueduct system, completed in May 1988, begins in the North Delta at the Barker Slough Facilities. Sacramento River water is conveyed through Cache, Lindsey, and Barker sloughs to the Barker Slough pumping plant. From the pumping plant, water is conveyed by pipe for 24 miles northwest to contractors in Napa and Solano Counties and to the Cordelia Pumping Plant. Deliveries are made to Solano County water users via turnouts along the pipe's length. From the Cordelia Pumping Plant, the North Bay Aqueduct terminates at the Napa Terminal Tank. The Aqueduct supplied 35,125 AF to Napa and Solano counties.

A division-wide total of 110,287 AF went to SWP entitlement contractors, 30,358 AF of Local Water

was conveyed to Alameda County Flood Control and Water Conservation District, Zone 7, and to the Alameda County Water District, 513 AF of Federal Wheeling to Musco Olive, Tracy Golf and Country Club, and the V. A. Cemetery, 2,000 AF of General Wheeling to Alameda County Flood Control and Water Conservation District, Zone 7, and 114 AF of Recreation water.

### Pumping Plants

Delta Field Division pumping plants include Barker Slough Pumping Plant and Cordelia Pumping Plant on the North Bay Aqueduct, Banks on the California Aqueduct, and South Bay and Del Valle Pumping Plants on the South Bay Aqueduct. Monthly pumping data is summarized for the year in Table 1.

Banks Pumping Plant was originally built to accommodate 11 units. Initially, seven pumps were constructed for a total pumping capacity of 6,400 cfs. Construction of the final four pumps was completed in 1990, each with a design capacity of 1,067 cfs and a new total capacity of 10,500 cfs. Export pumping rates are increased on weekends to take advantage of less costly off-peak electricity. This produces sharp peaks in the export rate at about 7-day intervals.

In 1998, The SWP diverted 1,687,410 AF of water at Banks Pumping Plant, including 28,087 AF of CVP water wheeled by the Department. Below is a five-year summary of federal, State, and total pumping at Banks:

Pumping at Banks Pumping Plant (in AF)			
Year	Federal	State	Total
1998	28,087	1,659,323	1,687,410
1997	201,033	2,343,653	2,544,686
1996	210,121	3,031,102	3,241,223
1995	28,417	2,088,462	2,116,879
1994	44,984	1,621,129	1,666,113

**Table 11. Lake Del Valle Monthly Operation**

**1998**

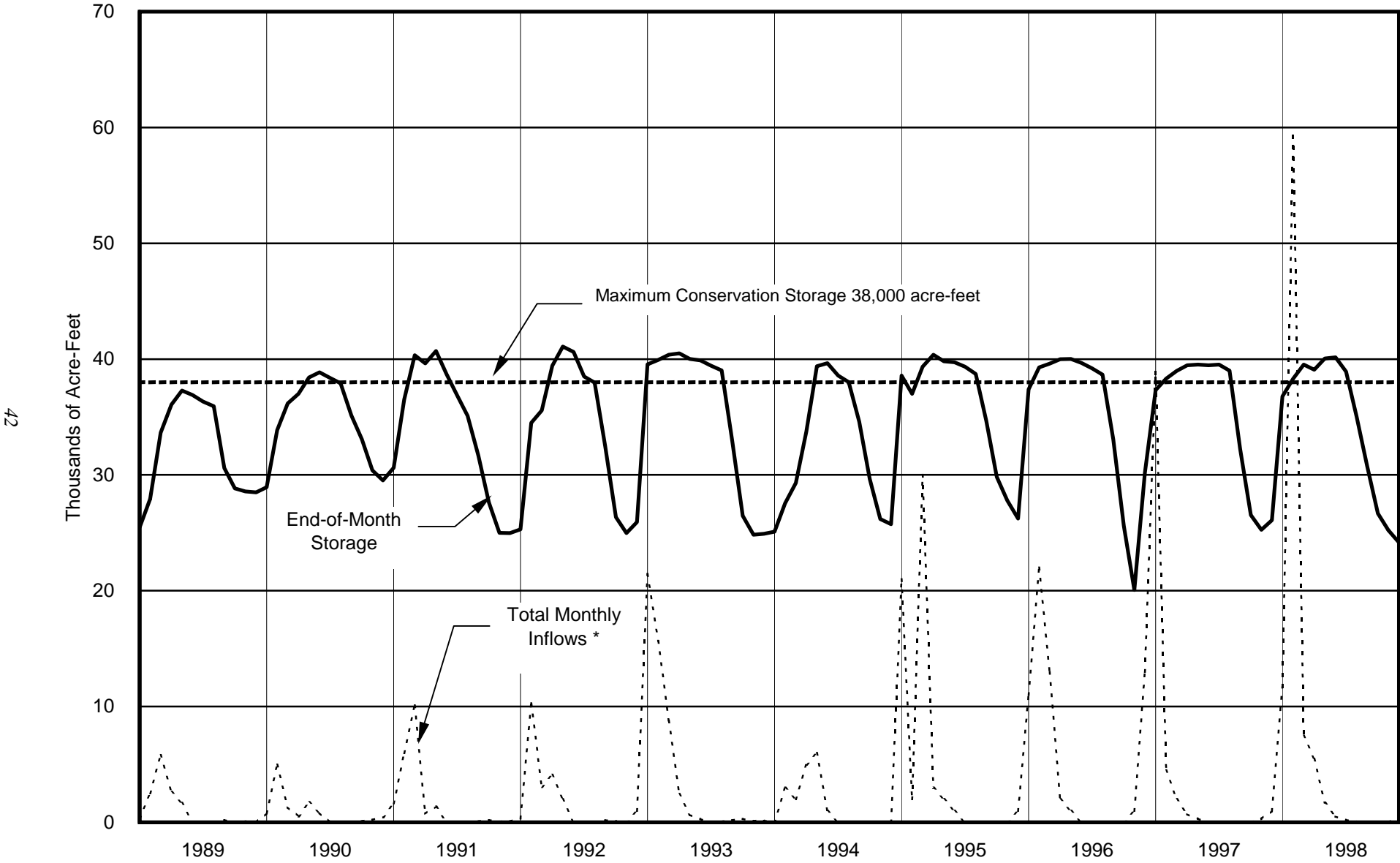
(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow		Outflow					Precipitation (inches)
				Natural	South Bay Aqueduct	Released To Arroyo Valle	Released to South Bay Aqueduct	Recreation 1/	Evaporation	Total	
Jan	698.46	36,783	10,690	11,788	0	0	1,054	0	44	1,098	5.21
Feb	700.72	38,322	1,539	59,305	0	56,408	1,317	1	40	57,766	9.12
Mar	702.46	39,533	1,211	7,523	0	770	5,434	2	106	6,312	2.74
Apr	701.82	39,085	-448	5,498	0	0	5,777	4	165	5,946	1.74
May	703.18	40,042	957	1,687	0	0	565	8	157	730	3.65
Jun	703.33	40,148	106	470	0	0	60	14	290	364	0.12
Jul	701.57	38,911	-1,237	234	0	0	1,020	24	427	1,471	0.00
Aug	695.84	35,045	-3,866	60	0	0	3,446	21	459	3,926	0.00
Sep	688.98	30,770	-4,275	22	0	0	3,961	20	316	4,297	0.13
Oct	681.70	26,670	-4,100	-18	0	0	3,888	12	182	4,082	0.56
Nov	678.89	25,220	-1,450	272	0	0	1,657	5	60	1,722	2.45
Dec	676.77	24,178	-1,042	424	0	0	2/ 1,415	3	48	1,466	0.99
Total	---	---	-1,915	87,265	0	57,178	29,594	114	2,294	89,180	26.71

1/ To East Bay Regional Park District.

2/ Includes 666 AF of water that was pumped by the Del Valle Pumping Plant.

Figure 15. Historical Lake Del Valle Operation



\* Natural and pumped inflows.

**Table 12. Clifton Court Forebay Monthly Operation**  
**1998**

(elevation in feet, storage in acre-feet)

Month	Water Surface Elevation	Storage	Storage Change	Inflow
Jan	0.25	18,802	-86	196,486
Feb	3.37	26,324	7,522	13,009
Mar	-2.72	13,386	-12,938	0
Apr	-2.86	12,122	-1,264	1,031
May	2.71	24,114	11,992	55,938
Jun	0.78	19,944	-4,170	127,275
Jul	0.83	20,052	108	219,811
Aug	1.55	21,606	1,554	272,450
Sep	0.08	18,435	-3,171	266,451
Oct	0.45	19,233	798	296,634
Nov	1.07	20,570	1,337	130,373
Dec	0.79	19,966	-604	127,422
Total	---	---	1,078	1,706,880

## ***San Luis Field Division***

### ***Water Storage***

San Luis Reservoir reached its maximum end-of-month storage for 1998, 2,028,725 AF (100 percent of maximum operating storage), at the end of May. Maximum operating storage capacity in San Luis is 2,027,835 AF. Minimum end-of-month storage for the year, 1,566,459 AF (77 percent of maximum operating storage) occurred in August. The State's share of San Luis Reservoir end-of-month storage reached the maximum of 1,074,166 AF in December (101 percent of State's maximum operating storage), and the minimum of 874,180 AF (82 percent of State's maximum operating storage) was reached in August. Table 13 shows San Luis Reservoir operations during 1998. Figure 16 shows San Luis Reservoir operations during the past ten years. Table 14 shows the monthly operation of O'Neill Forebay during 1998.

There are two different accounting procedures for calculating storage shares in O'Neill Forebay. One adjusts storage shares using actual SWP/USBR deliveries made from water out of O'Neill. The other method adjusts storage shares in O'Neill using amounts pumped for each agency derived from scheduled energy at Dos Amigos Pumping Plant. Since scheduled pumping and water deliveries never match, there is always a difference that is carried over into subsequent months. These mismatches are used to "underschedule" or "overschedule" energy and pumping in order to bring the mismatch back into alignment or closer to zero.

### ***Pumping and Generating Plants***

Total pumping in 1998 at Gianelli Pumping-Generating Plant was 1,099,349 AF. Water released from San Luis Reservoir to O'Neill Forebay for generation was 686,071 AF. Total pumping at Dos Amigos Pumping Plant in 1998 was 2,496,212 AF, 1,084,497 AF less than was pumped in 1997. Table 15 summarizes joint-use plant activity on a monthly basis.

### ***Water Deliveries***

SWP water deliveries in the San Luis Field Division during 1998 included 136,519 AF of State water to Westlands Water District and 742 AF of State and federal deliveries to the DFG and the Department of Parks and Recreation (DPR) from the O'Neill Forebay area and San Luis Reservoir (Reach 3). The following tabulation details the components of these recreation deliveries:

O'Neill Forebay and San Luis Reservoir (Reach 3)			
	DPR	DFG	Total
State	72	332	404
Federal	58	271	330
Sub-total	130	603	734
Pools 16, 17, & 18 (Reach 5)			
	DPR	DFG	Total
State	0	5	5
Federal	0	3	3
Sub-total	0	8	8

Federal deliveries from the joint-use facilities in the San Luis Field Division during 1998 totaled 1,019,813 AF.



**Table 13. San Luis Reservoir Monthly Operation**

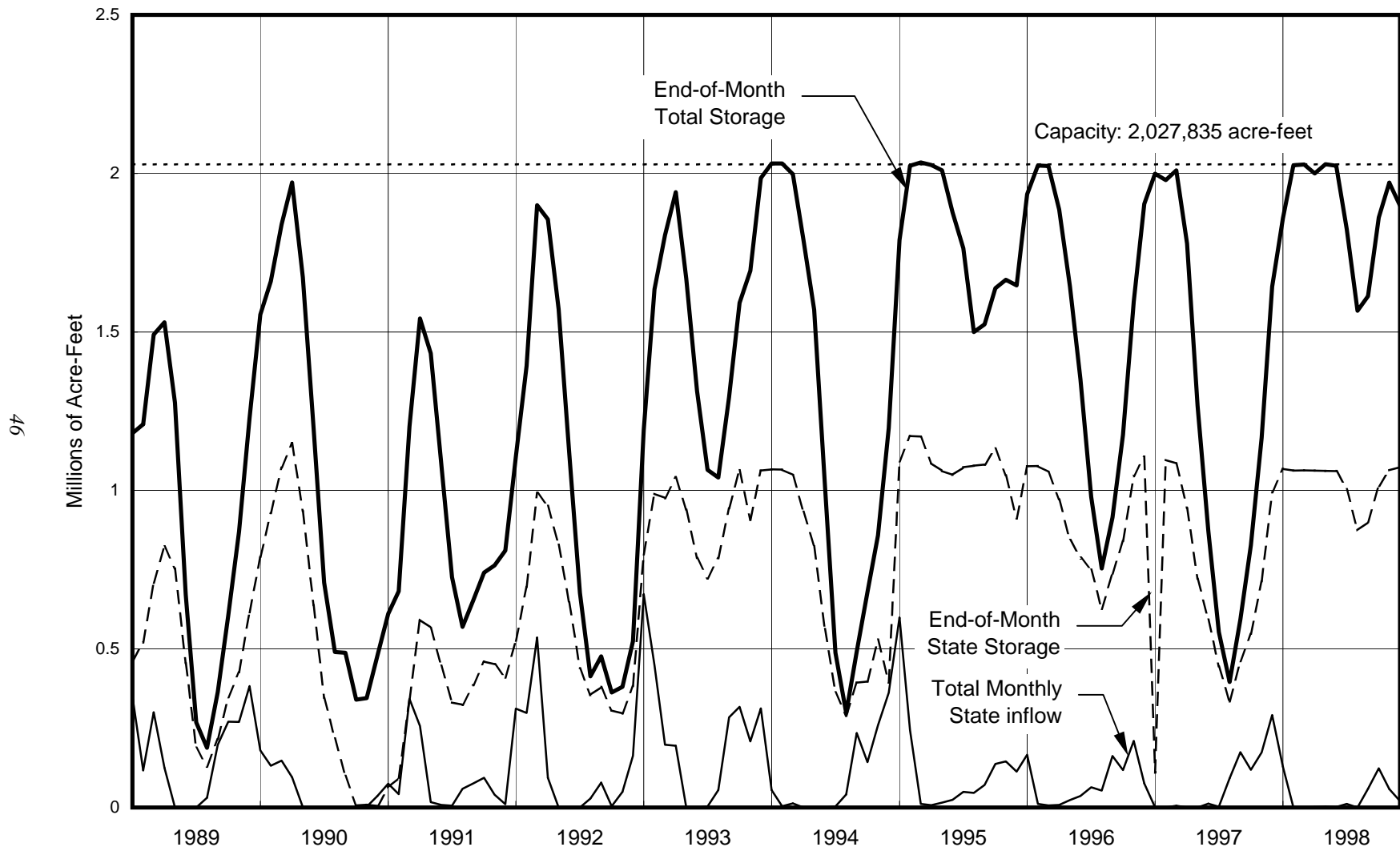
**1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow	Outflow			Gain (+) And Loss (-)
				Gianelli P-G Plant Pumping	Gianelli P-G Plant Generation	Pacheco Tunnel	Parks and Rec. Del. 1/	
Jan	529.49	1,858,715	215,733	283,227	47,355	7,793	0	-12,346
Feb	542.82	2,025,549	166,834	160,990	0	6,470	0	12,314
Mar	543.02	2,028,090	2,541	8,506	0	7,856	0	1,891
Apr	540.79	1,999,821	-28,269	6,844	26,374	8,052	0	-687
May	543.07	2,028,725	28,904	70,871	29,226	5,966	0	-6,775
Jun	542.70	2,024,025	-4,700	3,765	694	4,519	0	-3,252
Jul	526.69	1,824,308	-199,717	11,004	193,729	11,114	0	-5,878
Aug	505.09	1,566,459	-257,849	0	245,776	11,673	0	-400
Sep	509.08	1,613,068	46,609	106,753	39,062	10,969	0	-10,113
Oct	529.68	1,861,058	247,990	272,384	426	8,144	0	-15,824
Nov	538.49	1,970,810	109,752	155,078	22,287	5,413	0	-17,626
Dec	532.68	1,898,186	-72,624	19,927	81,142	6,100	13	-5,296
Total	---	---	255,204	1,099,349	686,071	94,069	13	-63,992

1/ This water was delivered throughout the year but recorded only in December for clarity.

Figure 16. Historical San Luis Reservoir Operation



**Table 14. O'Neill Forebay Monthly Operation**

**1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow				Outflow				Gain (+) And Losses (-)
				Pump In 1/	O'Neill P-G Plant Pumping	Gianelli P-G Plant Genertion	California Aqueduct Check 12	O'Neill P-G Plant Genertion	Gianelli P-G Plant Pumping	Dos Amigos Pumping	Deliveries	
Jan	220.57	44,635	-3,776	0	212,362	47,355	190,204	0	283,227	188,942	433	18,905
Feb	218.76	39,976	-4,659	2,677	169,034	0	8,340	0	160,990	44,981	67	21,328
Mar	222.51	49,740	9,764	386	103,093	0	13,527	0	8,506	105,541	219	7,024
Apr	219.46	41,759	-7,981	136	65,854	26,374	0	188	6,844	97,832	201	4,720
May	221.05	45,892	4,133	241	113,498	29,226	34,493	0	70,871	108,629	548	6,722
Jun	221.55	47,204	1,312	53	123,445	694	112,626	0	3,765	231,867	1,389	1,515
Jul	221.46	46,968	-236	22	139,532	193,729	194,247	0	11,004	515,923	3,843	3,004
Aug	223.00	51,046	4,078	0	37,659	245,776	243,790	595	0	518,229	3,766	-557
Sep	221.21	46,311	-4,735	0	75,023	39,062	251,878	0	106,753	260,581	1,294	-2,070
Oct	222.04	48,491	2,180	0	166,022	426	287,378	0	272,384	173,223	831	-5,208
Nov	220.26	43,827	-4,664	0	101,455	22,287	124,144	10,222	155,078	91,511	340	4,601
Dec	220.64	44,818	991	0	0	81,142	120,050	15,364	19,927	158,953	362	-5,595
Total	---	---	-3,593	3,515	1,306,977	686,071	1,580,677	26,369	1,099,349	2,496,212	13,293	54,389

1/ Pump-in located at Mile 79.67R.

**Table 15. Monthly Operations Summary, State-Federal San Luis Joint-Use Facilities**  
**1998**

(In acre-feet except as noted)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Check 12													
State	190,204	8,340	13,527	0	34,493	112,626	194,247	243,790	251,878	287,378	124,144	105,860	1,566,487
Federal	0	0	0	0	0	0	0	0	0	0	0	14,190	14,190
Total	190,204	8,340	13,527	0	34,493	112,626	194,247	243,790	251,878	287,378	124,144	120,050	1,580,677
O'Neill P-G Plant													
Amount Pumped													
State	0	0	12,497	1,513	0	0	0	0	0	0	0	0	14,010
Federal	212,362	169,034	90,596	64,341	113,498	123,445	139,532	37,659	75,023	166,022	101,455	0	1,292,967
Total	212,362	169,034	103,093	65,854	113,498	123,445	139,532	37,659	75,023	166,022	101,455	0	1,306,977
Generation													
Federal	0	0	0	188	0	0	0	595	0	0	10,222	15,364	26,369
O'Neill Forebay													
End-of-Month Storage													
State *	24,768	45,181	32,429	9,368	10,516	17,916	-22,660	-703	2,098	27,063	38,094	38,834	---
Federal *	19,867	-5,205	17,311	32,391	35,376	29,288	69,628	51,749	44,213	21,428	5,733	5,984	---
Total	44,635	39,976	49,740	41,759	45,892	47,204	46,968	51,046	46,311	48,491	43,827	44,818	---
San Luis Reservoir													
End-of-Month Storage													
State	1,068,144	1,062,283	1,063,335	1,062,262	1,061,916	1,060,914	1,004,121	874,162	900,063	1,014,929	1,063,682	1,074,170	---
Federal	790,571	963,266	964,755	937,559	966,809	963,111	820,187	692,297	713,005	846,129	907,128	824,016	---
Total	1,858,715	2,025,549	2,028,090	1,999,821	2,028,725	2,024,025	1,824,308	1,566,459	1,613,068	1,861,058	1,970,810	1,898,186	---
Gianelli P-G Plant													
Amount Pumped													
State	128,784	-134	12	1,252	3,437	1,481	11,004	0	58,619	123,995	58,052	19,927	406,429
Federal	154,443	161,124	8,494	5,592	67,434	2,284	0	0	48,134	148,389	97,026	0	692,920
Total	283,227	160,990	8,506	6,844	70,871	3,765	11,004	0	106,753	272,384	155,078	19,927	1,099,349
Generation													
State	47,355	0	0	1,947	57	694	64,564	129,739	27,156	426	-395	17,519	289,062
Federal	0	0	0	24,427	29,169	0	129,165	116,037	11,906	0	22,682	63,623	397,009
Total	47,355	0	0	26,374	29,226	694	193,729	245,776	39,062	426	22,287	81,142	686,071
Pacheco Tunnel													
Federal	7,793	6,470	7,856	8,052	5,966	4,519	11,114	11,673	10,969	8,144	5,413	6,100	94,069
Dos Amigos P.P.													
State	117,571	19,314	42,839	37,938	48,795	105,301	290,048	351,262	191,476	122,619	56,817	88,491	1,472,471
Federal	71,371	25,667	62,702	59,894	59,834	126,566	225,875	166,967	69,105	37,331	34,462	70,462	1,010,236
Other	0	0	0	0	0	0	0	0	0	13,273	232	0	13,505
Total	188,942	44,981	105,541	97,832	108,629	231,867	515,923	518,229	260,581	173,223	91,511	158,953	2,496,212

\* Negative storage values indicate a deficit in storage withdrawals versus amounts stored and positive values larger than the reservoir capacity indicate a surplus of amounts stored versus storage withdrawals.

## ***San Joaquin Field Division***

### ***Water Deliveries***

A total of 970,841 AF of State deliveries was made in the San Joaquin Field Division in 1998. Water types include entitlement water, operational flood release, exchange water, purchase water, Coastal fill water, and transfer water. Kern County Water Agency (KCWA) represented 78 percent of the total SWP water delivered within the Division.

In addition to SWP deliveries, 14,081 AF of federal water was wheeled through SWP facilities to be delivered to the Kern National Wildlife Refuge.

The San Joaquin Field Division is the only field division in the SWP where there are no water storage facilities. All deliveries made from the Aqueduct are

summarized in Table 22, and are totaled by agency and water type in Map 2 and Table 2.

### ***Pumping Plants***

Pumping plants in the San Joaquin Field Division include Las Perillas and Badger Hill on the Coastal Aqueduct, and Buena Vista, Teerink, Chrisman, and Edmonston on the California Aqueduct. A complete monthly summary of amounts pumped at all of these plants is shown on Table 1. A summary of energy used to pump at each plant is shown on Table 4.

During 1998, 1,376,296 AF of State water and 14,081 AF of federal water flowed past Check 21 into the San Joaquin Field Division. Edmonston Pumping Plant pumped 564,121 AF during 1998.

## ***Southern Field Division***

### ***Water Storage***

There are four storage reservoirs in the Southern Field Division (Pyramid, Castaic, Silverwood, and Perris) with a combined storage capacity of 701,320 AF. Combined storage at the beginning of the year was 613,725 AF. End-of-year combined storage was 627,710 AF. Complete monthly operation tables for all four reservoirs plus Elderberry Forebay and Castaic Lagoon, along with historical inflow and storage data for the last ten years, is summarized in Tables 16 through 21 and Figures 17 through 20.

### ***Water Deliveries***

SWP deliveries in the Southern Field Division totaled 622,524 AF. Thirteen agencies received the water, which was almost all entitlement water. One exception was 1,585 AF of recreation water to the California Department of Parks and Recreation.

### ***Pumping and Generating Plants***

Pumping plants in the Southern Field Division include Oso and Castaic on the West Branch, and Pearblossom on the East Branch. A complete monthly summary of amounts pumped is shown on Table 1. A summary of energy used to pump and station service energy at each plant is shown on Table 4.

Generating plants in the Southern Field Division include Warne and Castaic on the West Branch, and Alamo, Mojave Siphon, and Devil Canyon on the East Branch. Energy available from each generating plant is summarized in Table 3. Combined generation at all five plants in 1998 totaled 765,480 MWh.

**Table 16. Pyramid Lake Monthly Operation  
1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Natural Inflow Storage Shares	Storage Change	Inflow			Outflow			Computed Losses (-) Ans Gains (+)
					Project		Natural Stream Flow	Project		Natural To Piru Creek 2/	
					Castaic Powerplant Pumpback 1/	Warne Powerplant		Castaic Powerplant Generation	Recreation Deliveries		
Jan	2576.12	167,485	-779	64	52,864	19,107	2,577	74,323	0	549	388
Feb	2577.13	168,780	4/ 0	1,295	35,879	7,447	66,110	63,542	0	43,287	-1,312
Mar	2572.99	163,514	4/ 0	-5,266	50,544	0	16,723	65,446	0	9,086	1,999
Apr	2567.13	156,245	4/ 0	-7,269	69,796	0	14,558	88,155	0	2,539	-929
May	2576.52	167,997	4/ 1,489	11,752	93,949	0	16,102	97,518	0	1,530	749
Jun	2569.59	159,270	6,508	-8,727	112,755	3/ 4,088	6,493	128,189	0	1,474	-2,400
Jul	2569.37	158,998	7,702	-272	139,908	20,978	2,742	159,089	0	1,548	-3,263
Aug	2570.86	160,847	7,557	1,849	119,661	26,984	1,422	142,906	0	1,567	-1,745
Sep	2570.79	160,760	7,253	-87	93,084	18,798	1,445	110,892	0	1,749	-773
Oct	2572.37	162,734	4,057	1,974	107,379	19,026	1,453	123,982	0	4,649	2,747
Nov	2573.51	164,169	331	1,435	86,147	7,817	1,639	89,965	0	5,365	1,162
Dec	2569.60	159,283	-606	-4,886	77,207	23	1,871	82,236	0	2,808	1,057
Total	---	---	---	-8,138	1,039,173	124,268	133,135	1,226,243	0	76,151	-2,320

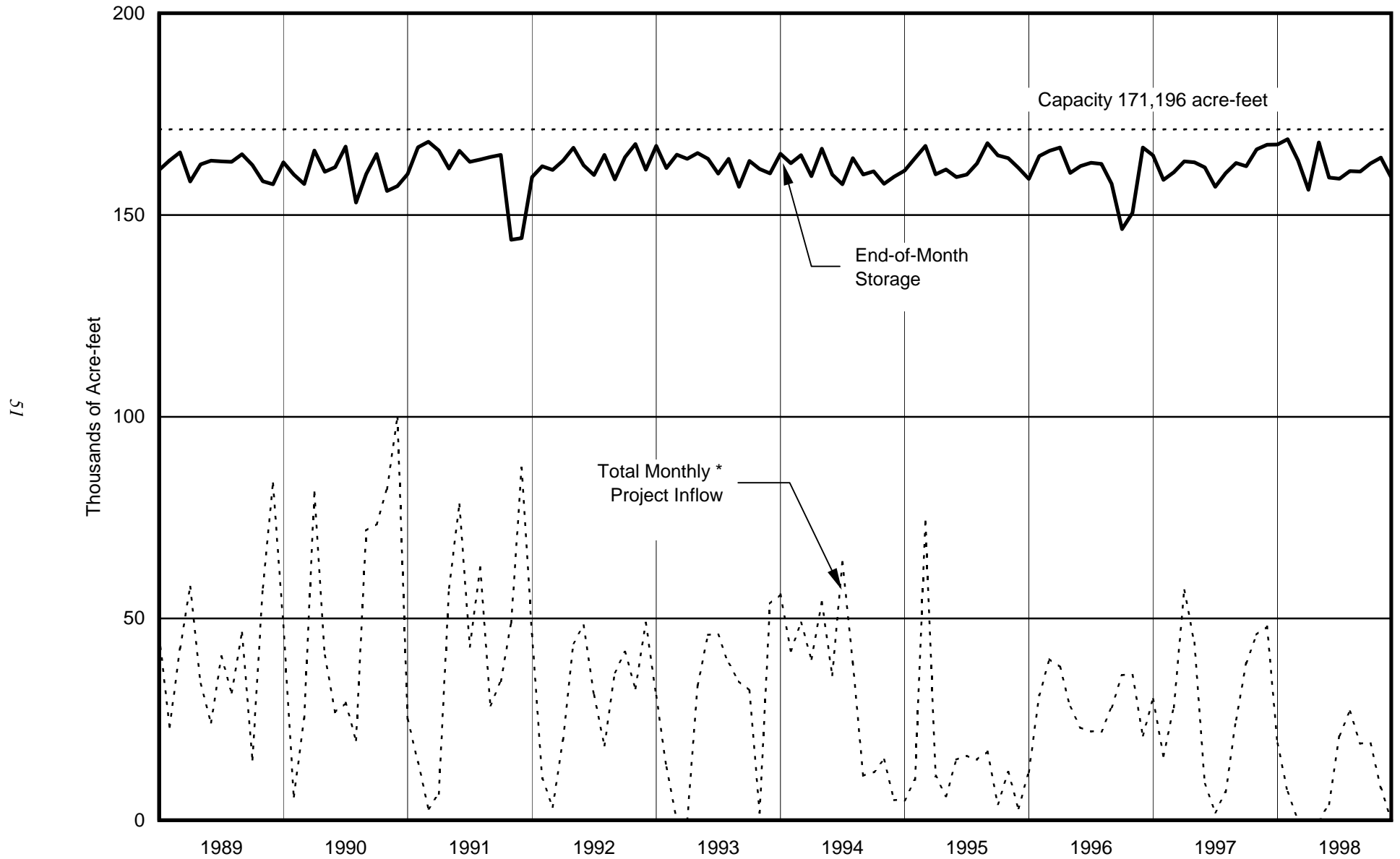
1/ Pumpback by Los Angeles Department of Water and Power (LADWP) from Elderberry Forebay through Castaic powerplant.

2/ Portions of these amounts are used to satisfy fishery enhancement agreement.

3/ 378 AF bypassed thru plant

4/ 22,044 AF appropriataed in Feb 98; 7,637 AF appropriated in March; 12,019 AF appropriated in April; 13,083 AF appropriated in May.  
Piru Lake spill beginning of Feb. 98. Piru Lake stopped spilling and appropriation stopped on 5-27-98.

Figure 17. Historical Pyramid Lake Operation



\* Excludes pumpback by LADWP through Castaic Powerplant.

**Table 17. Elderberry Forebay Monthly Operation  
1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow		Outflow			Computed Losses (-) And Gains (+)
				Castaic Powerplant Generation	Natural Stream Flow	Castaic Powerplant Pumpback 1/	To Castaic Lake		
							Natural	Project	
Jan	1508.92	18,773	2,695	74,323	478	52,864	478	18,152	-612
Feb	1517.35	22,125	3,352	63,542	24,738	35,879	24,738	22,531	-1,780
Mar	1527.67	26,613	4,488	65,446	5,274	50,544	5,274	9,728	-686
Apr	1531.38	28,324	1,711	88,155	5,160	69,796	5,160	16,893	245
May	1512.13	20,013	-8,311	97,518	7,686	93,949	7,686	8,152	-3,728
Jun	1526.58	26,121	6,108	128,189	2,582	112,755	2,582	9,061	-265
Jul	1519.41	22,990	-3,131	159,089	856	139,908	856	22,793	481
Aug	1523.02	24,544	1,554	142,906	271	119,661	271	22,665	974
Sep	1515.78	21,478	-3,066	110,892	245	93,084	245	19,618	-1,256
Oct	1512.57	20,187	-1,291	123,982	213	107,379	213	14,911	-2,983
Nov	1511.00	19,571	-616	89,965	299	86,147	299	2,125	-2,309
Dec	1519.60	23,070	3,499	82,236	432	77,207	0	0	-1,962
Total	- - -	- - -	6,992	1,226,243	48,234	1,039,173	47,802	166,629	-13,881

1/ Pumpback by Los Angeles Department of Water and Power (LADWP) through Castaic Power Plant.

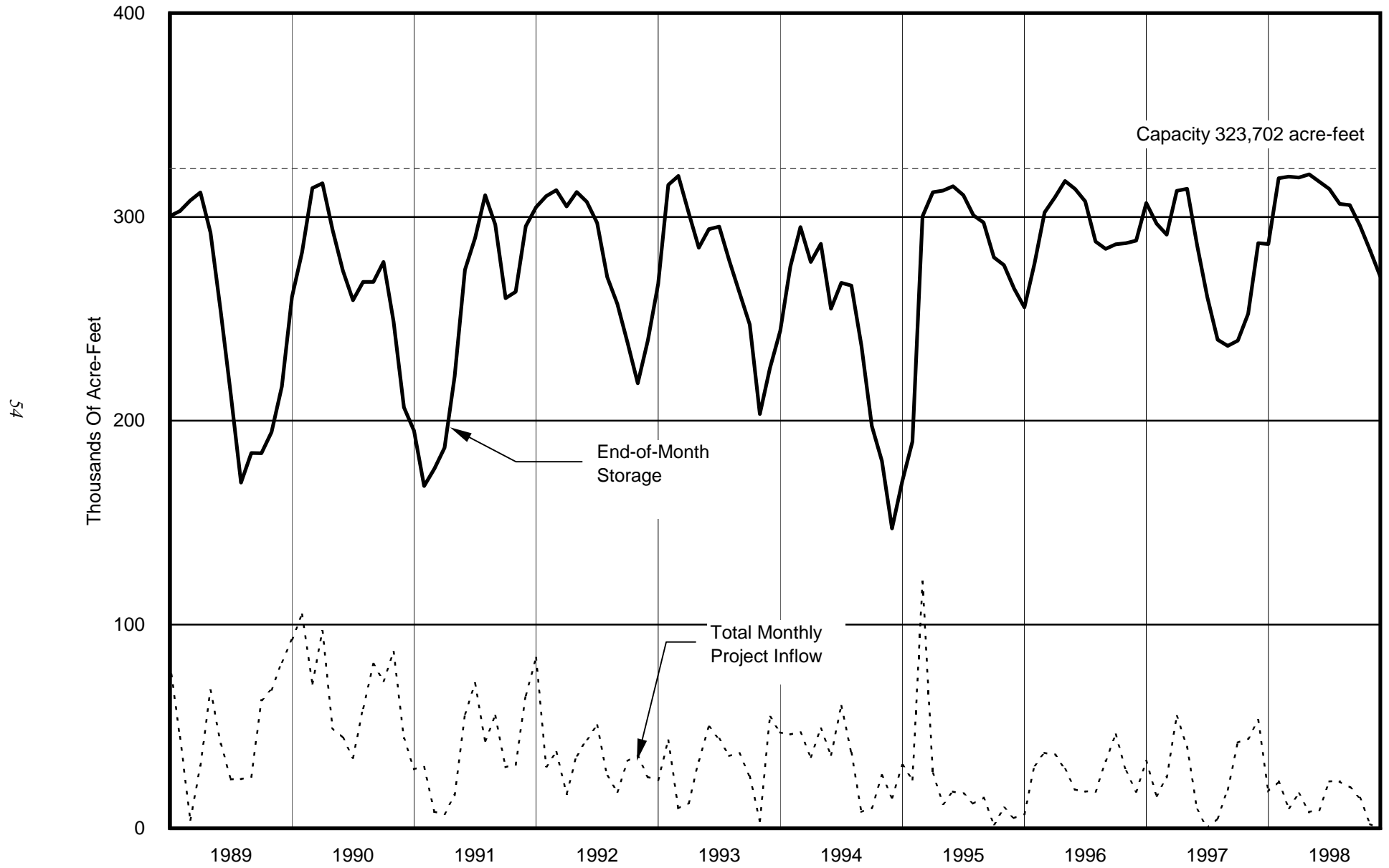


**Table 18. Castaic Lake Monthly Operation  
1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Natural Inflow Storage Shares	Storage Change	Inflow			Outflow		Computed Losses (-) Gains (+)
					From Elderberry Forebay		Natural	Deliveries	ReleasedTo Castaic Lagoon	
					Natural	Project				
Jan	1,497.85	286,691	143	-396	478	18,152	353	18,101	1,372	94
Feb	1,512.85	318,914	0	32,223	24,738	22,531	18,914	13,762	19,778	-420
Mar	1,513.25	319,801	0	887	5,274	9,728	6,360	8,757	10,778	-940
Apr	1,513.05	319,358	0	-443	5,160	16,893	6,185	21,845	4,596	-2,240
May	1,513.75	320,912	0	1,554	7,686	8,152	10,771	15,624	7,748	-1,683
Jun	1,512.10	317,255	48	-3,657	2,582	9,061	3,100	17,951	186	-263
Jul	1,510.49	313,710	559	-3,545	856	22,793	1,301	26,590	1,646	-259
Aug	1,507.10	306,323	455	-7,387	271	22,665	389	28,718	764	-1,230
Sep	1,506.85	305,783	424	-540	245	19,618	358	17,724	634	-2,403
Oct	1,502.20	295,828	470	-9,955	213	14,911	337	25,166	504	254
Nov	1,496.24	283,352	222	-12,476	299	2,125	400	13,726	947	-627
Dec	1,490.04	270,710	109	-12,642	0	0	527	11,278	1,072	-819
Total	---	---	---	-16,377	47,802	166,629	48,995	219,242	50,025	-10,536

Figure 18. Historical Castaic Lake Operation



**Table 19. Castaic Afterbay Monthly Operation  
1998**

(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow	Natural Outflow		Deliveries to Recreation	Computed Losses (-) And Gains (+)
					Release From Castaic Lagoon			
					Surface	Sub-Surface		
Jan	1136.51	5,762	90	1,372	1,186	62	34	0
Feb	1137.42	5,943	181	19,778	19,545	28	24	0
Mar	1136.73	5,806	-137	10,778	10,747	31	50	-87
Apr	1136.25	5,711	-95	4,596	4,566	30	55	-40
May	1136.46	5,752	41	7,748	7,561	31	115	0
Jun	1136.70	5,800	48	186	0	47	91	0
Jul	1136.59	5,778	-22	1,646	1,370	155	143	0
Aug	1136.57	5,774	-4	764	436	155	177	0
Sep	1136.13	5,687	-87	634	464	155	102	0
Oct	1136.00	5,662	-25	504	302	124	103	0
Nov	1136.54	5,768	106	947	652	120	69	0
Dec	1136.41	5,743	-25	1,072	926	124	47	0
Total	---	---	71	50,025	47,755	1,062	1,010	-127

**Table 20. Silverwood Lake Monthly Operation**  
**1998**

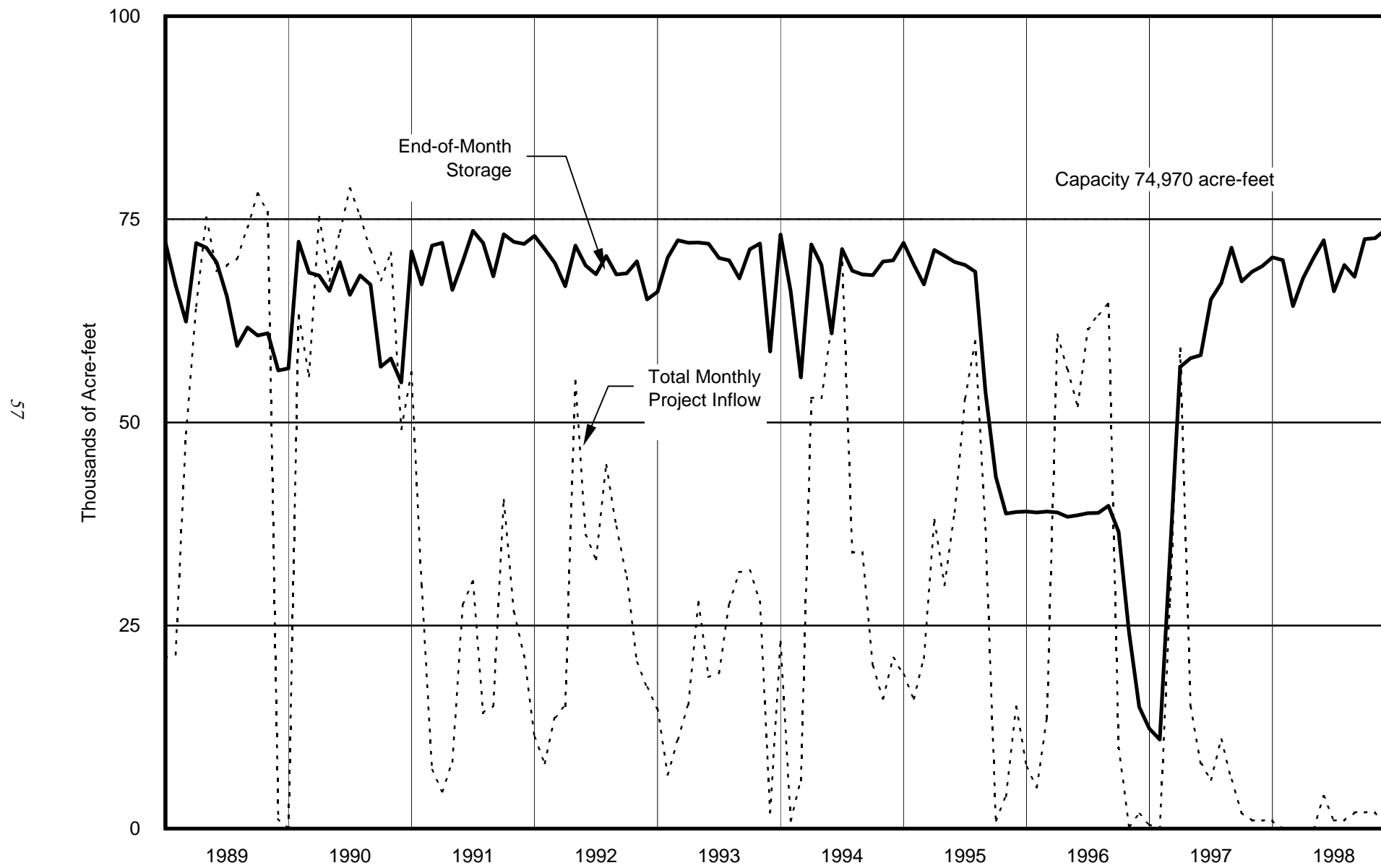
(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow			Outflow				Computed Loss (-) And Gains (+)	Total Natural Inflow Released 2/
				Mojave Siphon Powerplant	Mojave Bypass Flume	Natural 1/	Project			Natural Inflow to Mojave River		
							Delivered to CLAWA	Recreation	San Bernardino Tunnel			
Jan	3,350.15	70,319	1,090	12,052	1,112	827	80	1	12,928	87	195	886
Feb	3,349.77	69,960	-359	367	0	13,948	55	1	8,651	7,208	1,241	7,444
Mar	3,343.61	64,300	-5,660	10,710	174	6,560	17	1	18,035	5,134	83	5,253
Apr	3,347.43	67,780	3,480	53,434	0	6,781	30	1	50,825	5,240	-639	6,594
May	3,350.07	70,242	2,462	44,934	243	9,177	35	4	42,833	7,754	-1,266	9,105
Jun	3,352.36	72,417	2,175	39,799	3,891	2,860	41	7	42,390	1,733	-204	3,055
Jul	3,345.62	66,118	-6,299	39,623	608	839	103	12	46,081	151	-1,022	1,547
Aug	3,349.15	69,379	3,261	53,784	1,049	172	100	11	50,738	11	-884	463
Sep	3,351.15	71,264	1,885	38,617	1,994	80	84	6	37,528	11	-1,177	1,008
Oct	3,352.52	72,571	1,307	28,938	1,816	74	58	6	28,740	12	-705	450
Nov	3,352.64	72,686	115	9,244	1,545	148	41	2	10,785	11	17	172
Dec	3,353.70	73,707	1,021	7,723	904	219	60	1	7,317	12	-435	431
Total	---	---	4,478	339,225	13,336	41,685	704	53	356,851	27,364	-4,796	36,408

1/ Houston Creek appropriation included in total.

2/ Total releases made from Mojave Siphon to Las Flores Ranch Co., in exchange for natural inflow stored in lake, and from Silverwood Lake to Mojave River from outlet for Mojave W.A. The difference between this total column and the natural inflow released to Mojave River equals the Las Flores Ranch.

Figure 19. Historical Silverwood Lake Operation



**Table 21. Lake Perris Monthly Operation  
1998**

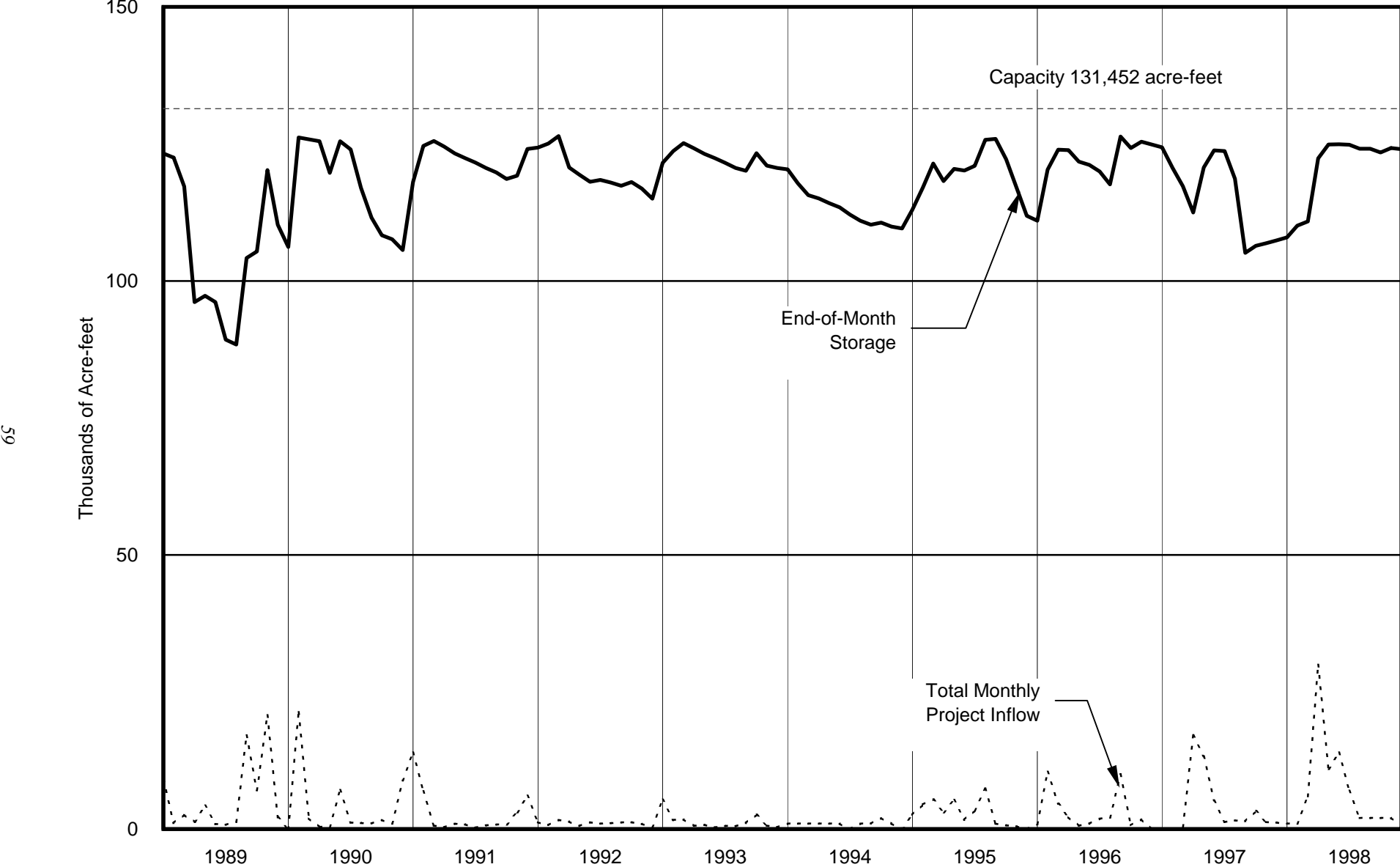
(in acre-feet except as noted)

Month	Water Surface Elevation (in feet)	Storage	Storage Change	Inflow  1/	Outflow  2/	Computed Losses (-) And Gains (+)
Jan	1579.51	107,949	582	783	293	92
Feb	1580.50	110,095	2,146	848	287	1,585
Mar	1580.84	110,835	740	6,486	5,217	-529
Apr	1586.03	122,355	11,520	29,982	18,435	-27
May	1587.15	124,898	2,543	10,683	7,837	-303
Jun	1587.17	124,944	46	14,033	13,116	-871
Jul	1587.12	124,829	-115	7,290	6,323	-1,082
Aug	1586.80	124,101	-728	2,214	1,711	-1,231
Sep	1586.80	124,101	0	1,733	358	-1,375
Oct	1586.51	123,442	-659	2,204	1,814	-1,049
Nov	1586.86	124,237	795	1,769	331	-643
Dec	1586.76	124,010	-227	1,274	352	-1,149
Total	---	---	16,643	79,299	56,074	-6,582

1/ Calculated.

2/ Includes deliveries to MWD at Reach 28J and recreation water to California State Park.

Figure 20. Historical Lake Perris Operation



**Table 22a. Summary of California Aqueduct Operation  
1998**

(in acre-feet)

Description	Jan	Feb	Mar	Apr	May	Jun
<b>DELTA FIELD DIVISION</b>						
Note: North Bay Aqueduct, South Bay Aqueduct, and Lake Del Valle they are shown here						
North Bay Aqueduct						
Pumped at Barker Slough Pumping Plant	1,383	2,589	2,161	2,220	2,316	3,370
Deliveries (Travis & Fairfield/Vacaville)	150	983	636	330	171	1,142
Pumped at Cordelia Pumping Plant	1,221	1,541	1,444	1,742	2,149	2,083
Deliveries (Benicia, Vallejo, A.C. 1&2, & Napa)	1,221	1,541	1,444	1,742	2,149	2,083
Computed Losses (-), Gains (+)	-12	-65	-81	-148	4	-145
California Aqueduct						
Pumped at Banks Pumping Plant	196,584	7,285	14,315	1,871	43,225	128,947
Pumped at South Bay Pumping Plant	3,655	419	534	942	7,243	12,352
Delivered to Contracting Agencies	1	0	24	76	218	809
Delivered to Fed. Customers	37	29	37	35	33	28
Change in Storage	61	-77	-581	-171	687	575
Outflow at Check 12	190,204	8,340	13,527	0	34,493	112,626
Computed Losses (-), Gains (+)	-2,626	1,426	-774	-989	-551	-2,557
South Bay Aqueduct						
Inflow from Lake Del Valle (Flood Control)	0	59	2,301	1,742	0	0
Pumped at South Bay Pumping Plant	3,655	419	534	942	7,243	12,352
Inflow from Lake Del Valle (Natural)	1,054	1,258	3,133	3,119	0	0
Inflow from Lake Del Valle (Project)	0	0	0	916	0	0
Inflow from Lake Del Valle (Contractor's Stored)	0	0	0	0	565	60
Outflow, Flood Control	0	59	2,301	1,742	0	0
Outflow, Deliveries	4,699	1,612	3,604	4,803	7,798	12,402
Computed Losses (-), Gains (+)	-10	-65	-63	-174	-10	-10
Lake Del Valle Operation:						
Natural inflow	11,788	59,305	7,523	5,498	1,687	470
Releases to South Bay Aqueduct	1,054	1,317	5,434	5,777	565	60
Releases to Arroyo Valle	0	56,408	770	0	0	0
Delivered to EBRP District	0	1	2	4	8	14
End-of-Month Storage	36,783	38,322	39,533	39,085	40,042	40,148
Change in Storage	10,690	1,539	1,211	-448	957	106
Computed Losses (-), Gains (+)	-44	-40	-106	-165	-157	-290
<b>SAN LUIS FIELD DIVISION</b>						
O'Neill Forebay Operation						
End-of-Month Storage	44,635	39,976	49,740	41,759	45,892	47,204
Inflow, California Aqueduct	190,204	8,340	13,527	0	34,493	112,626
Inflow, O'Neill P.- G. Plant	212,362	169,034	103,093	65,854	113,498	123,445
Inflow, Gianelli P.- G. Plant	47,355	0	0	26,374	29,226	694
Pump-in/sideflows/Sisk Dam spill	0	2,677	386	136	241	53
Delivered to Dept. of Fish and Game (State)	13	0	0	2	0	0
Delivered to Dept. of Fish and Game (Fed.)	10	0	0	1	0	0
Delivered to Dept. of Parks & Rec. (Fed.)	0	0	0	0	0	0
Delivered to Dept. of Parks & Rec. (State)	0	0	0	0	0	0
Delivered to Fed. Customers	410	67	219	198	548	1,389
Outflow, O'Neill P.- G. Plant	0	0	0	188	0	0
Outflow, Gianelli P.- G. Plant	283,227	160,990	8,506	6,844	70,871	3,765
Outflow, Dos Amigos P.P.	188,942	44,981	105,541	97,832	108,629	231,867
Change in Storage	-3,776	-4,659	9,764	-7,981	4,133	1,312
Computed Losses (-), Gains (+)	18,905	21,328	7,024	4,720	6,723	1,515
San Luis Reservoir Operation						
State End-of-Month Storage	1,068,144	1,062,283	1,063,335	1,062,262	1,061,916	1,060,914
Total End-of-Month Storage	1,858,715	2,025,549	2,028,090	1,999,821	2,028,725	2,024,025
Inflow, Gianelli P.- G. Plant	283,227	160,990	8,506	6,844	70,871	3,765
Outflow, Gianelli P. - G. Plant	47,355	0	0	26,374	29,226	694
Delivered to Dept. of Parks & Rec. (Fed.)	0	0	0	0	0	0
Delivered to Dept. of Parks & Rec. (State)	0	0	0	0	0	0
Pacheco Tunnel Diversion	7,793	6,470	7,856	8,052	5,966	4,519
Change in Storage (Total)	215,733	166,834	2,541	-28,269	28,904	-4,700
Computed Losses (-), Gains (+)	-12,346	12,314	1,891	-687	-6,775	-3,252



**Table 22a. Summary of California Aqueduct Operations**

**1998**

(in acre-feet)

Jul	Aug	Sep	Oct	Nov	Dec	Total	Description
are not within the Edmond G. Brown California Aqueduct, for completeness.							DELTA FIELD DIVISION
							North Bay Aqueduct
5,690	5,857	4,323	2,080	1,659	2,820	36,468	Pumped at Barker Slough Pumping Plant
2,897	2,939	1,815	253	125	121	11,562	Deliveries (Travis & Fairfield/Vacaville)
2,493	2,723	2,343	1,739	1,475	2,610	23,563	Pumped at Cordelia Pumping Plant
2,493	2,723	2,343	1,739	1,475	2,610	23,563	Deliveries (Benicia, Vallejo, A.C. 1&2, & Napa)
-300	-195	-165	-88	-59	-89	-1,343	Computed Losses (-), Gains (+)
							California Aqueduct
213,401	263,272	266,204	294,791	129,489	128,026	1,687,410	Pumped at Banks Pumping Plant
13,988	12,800	9,383	5,119	4,575	7,126	78,136	Pumped at South Bay Pumping Plant
1,124	1,130	594	277	12	21	4,286	Delivered to Contracting Agencies
38	29	66	80	53	48	513	Delivered to Fed. Customers
-330	320	87	-473	144	-298	-56	Change in Storage
194,247	243,790	251,878	287,378	124,144	120,050	1,580,677	Outflow at Check 12
-4,334	-5,203	-4,196	-2,410	-561	-1,079	-23,854	Computed Losses (-), Gains (+)
							South Bay Aqueduct
0	0	0	0	0	0	4,102	Inflow from Lake Del Valle (Flood Control)
13,988	12,800	9,383	5,119	4,575	7,126	78,136	Pumped at South Bay Pumping Plant
0	60	22	0	272	424	9,342	Inflow from Lake Del Valle (Natural)
0	3,386	3,939	3,888	1,385	991	14,505	Inflow from Lake Del Valle (Project)
1,020	0	0	0	0	0	1,645	Inflow from Lake Del Valle (Contractor's Stored)
0	0	0	0	0	0	4,102	Outflow, Flood Control
14,998	16,236	13,334	8,997	6,222	8,529	103,234	Outflow, Deliveries
-10	-10	-10	-10	-10	-12	-394	Computed Losses (-), Gains (+)
							Lake Del Valle Operation:
234	60	22	-18	272	424	87,265	Natural inflow
1,020	3,446	3,961	3,888	1,657	1/ 1,415	29,594	Releases to South Bay Aqueduct
0	0	0	0	0	0	57,178	Releases to Arroyo Valle
24	21	20	12	5	3	114	Delivered to EBRP District
38,911	35,045	30,770	26,670	25,220	24,178	- - -	End-of-Month Storage
-1,237	-3,866	-4,275	-4,100	-1,450	-1,042	-1,915	Change in Storage
-427	-459	-316	-182	-60	-48	-2,294	Computed Losses (-), Gains (+)
							SAN LUIS FIELD DIVISION
							O'Neill Forebay Operation
46,968	51,046	46,311	48,491	43,827	44,818	- - -	End-of-Month Storage
194,247	243,790	251,878	287,378	124,144	120,050	1,580,677	Inflow, California Aqueduct
139,532	37,659	75,023	166,022	101,455	0	1,306,977	Inflow, O'Neill P.- G. Plant
193,729	245,776	39,062	426	22,287	81,142	686,071	Inflow, Gianelli P.- G. Plant
22	0	0	0	0	0	3,515	Pump-in/sideflows/Sisk Dam spill
0	3	0	87	148	79	332	Delivered to Dept. of Fish and Game (State)
0	3	0	71	121	65	271	Delivered to Dept. of Fish and Game (Fed.)
0	0	0	0	0	53	53	Delivered to Dept. of Parks & Rec. (Fed.)
0	0	0	0	0	65	65	Delivered to Dept. of Parks & Rec. (State)
3,843	3,760	1,294	673	71	100	12,572	Delivered to Fed. Customers
0	595	0	0	10,222	15,364	26,369	Outflow, O'Neill P.- G. Plant
11,004	0	106,753	272,384	155,078	19,927	1,099,349	Outflow, Gianelli P.- G. Plant
515,923	518,229	260,581	173,223	91,511	158,953	2,496,212	Outflow, Dos Amigos P.P.
-236	4,078	-4,735	2,180	-4,664	991	-3,593	Change in Storage
3,004	-557	-2,070	-5,208	4,601	-5,595	54,390	Computed Losses (-), Gains (+)
							San Luis Reservoir Operation
1,004,121	874,162	900,063	1,014,929	1,063,682	1,074,170	- - -	State End-of-Month Storage
1,824,308	1,566,459	1,613,068	1,861,058	1,970,810	1,898,186	- - -	Total End-of-Month Storage
11,004	0	106,753	272,384	155,078	19,927	1,099,349	Inflow, Gianelli P.- G. Plant
193,729	245,776	39,062	426	22,287	81,142	686,071	Outflow, Gianelli P. - G. Plant
0	0	0	0	0	6	6	Delivered to Dept. of Parks & Rec. (Fed.)
0	0	0	0	0	7	7	Delivered to Dept. of Parks & Rec. (State)
11,114	11,673	10,969	8,144	5,413	6,100	94,069	Pacheco Tunnel Diversion
-199,717	-257,849	46,609	247,990	109,752	-72,624	255,204	Change in Storage (Total)
-5,878	-400	-10,113	-15,824	-17,626	-5,296	-63,992	Computed Losses (-), Gains (+)

**Table 22b. Summary of California Aqueduct Operation**

**1998**  
(in acre-feet)

Description	Jan	Feb	Mar	Apr	May	Jun
<b>SAN LUIS FIELD DIVISION (Cont.)</b>						
California Aqueduct (Pools 14 thru 21)	68,183	34,392	60,121	58,395	68,775	137,693
Inflow, Dos Amigos P.P.(State)	117,571	19,314	42,839	37,938	48,795	105,301
Inflow, Dos Amigos P.P.(Fed. and Other)	71,371	25,667	62,702	59,894	59,834	126,566
Total Inflow, Dos Amigos P.P.	188,942	44,981	105,541	97,832	108,629	231,867
Flow into Aqueduct	40	15,788	901	1,122	4,145	3,138
Delivered to Dept. of Fish and Game (State)	0	0	0	0	0	0
Delivered to Dept. of Fish and Game (Fed.)	0	0	0	0	0	0
Miscellaneous Outflow (Phase 1)	8	0	0	5	8	4
Delivered to Fed. Customers (State Transfers)	1,684	0	0	0	7,562	12,550
Delivered to Fed. Customers	66,491	34,392	60,121	58,390	61,205	125,139
Outflow, Check 21 (State)	111,894	31,331	38,029	35,871	37,730	86,827
Outflow, Check 21 (Fed.)	1,101	0	0	0	0	0
Change in Storage	-616	-1,353	1,656	-597	846	483
Computed Losses (-), Gains (+)	-8,420	3,601	-6,636	-5,285	-5,423	-10,002
<b>SAN JOAQUIN FIELD DIVISION</b>						
California Aqueduct, Check 21 to Buena Vista Pumping Plant						
Inflow, Check 21 (State)	111,894	31,331	38,029	35,871	37,730	86,827
Inflow, Check 21 (Fed.)	1,101	0	0	0	0	0
Total Inflow, Check 21	112,995	31,331	38,029	35,871	37,730	86,827
Kern River Intertie	0	0	0	42,282	59,160	68,741
Delivered to Contracting State Agencies	66,068	20,936	11,473	16,364	23,244	52,021
Delivered to Fed. Customers	1,101	0	0	0	0	0
Friant CVP Inflow	0	0	0	7,838	2,560	0
Outflow, Buena Vista P.P.	40,498	10,427	19,581	61,630	64,090	82,303
Coastal Br. Diversion	2,744	1,643	5,890	8,312	9,590	16,838
Change in Storage	322	-935	1,183	-1,289	819	-501
Computed Losses (-), Gains (+)	-2,262	740	98	-974	-1,707	-4,907
California Aqueduct, Buena Vista P.P. to Teerink Pumping Plant						
Inflow, Buena Vista P.P.	40,498	10,427	19,581	61,630	64,090	82,303
Delivered to Contracting State Agencies	2,556	2,308	3,371	3,218	5,839	15,448
W.R.M.W.S.D. Pumpback	0	0	0	0	0	0
Outflow, Teerink Pumping Plant	39,300	8,275	15,846	60,358	60,186	70,069
Change in Storage	-15	-277	485	-191	204	-351
Computed Losses (-), Gains (+)	1,343	-121	121	1,755	2,139	2,863
California Aqueduct, Teerink Pumping Plant to Chrisman Pumping Plant						
Inflow, Teerink Pumping Plant	39,300	8,275	15,846	60,358	60,186	70,069
Delivered to Contracting State Agencies	367	48	969	977	3,193	4,781
Outflow, Chrisman Pumping Plant	38,235	8,117	14,468	58,392	55,453	62,992
Change in Storage	26	0	0	-13	40	-6
Computed Losses (-), Gains (+)	-672	-110	-409	-1,002	-1,500	-2,302
California Aqueduct, Chrisman Pumping Plant to Edmonston Pumping Plant						
Inflow, Chrisman Pumping Plant	38,235	8,117	14,468	58,392	55,453	62,992
Delivered to Contracting State Agencies	642	407	550	436	2,236	3,591
Outflow, Edmonston Pumping Plant	38,149	8,050	13,471	57,728	52,814	59,989
Change in Storage	12	-281	326	-106	-18	16
Computed Losses (-), Gains (+)	568	60	-122	-334	-421	604
Coastal Branch, California Aqueduct						
Inflow, Las Perillas P.P.	2,744	1,643	5,890	8,312	9,590	16,838
B.M.W.S.D. Pumpback	0	0	0	0	0	0
Delivered to Contracting State Agencies	2,325	1,664	5,335	7,449	8,918	15,283
Delivered to Fed. Customers	0	0	0	0	0	0
Change in Storage	14	-19	-1	-8	26	0
Computed Losses (-), Gains (+)	-406	3	-556	-871	-646	-1,555

**Table 22b. Summary of California Aqueduct Operations**

**1998**  
(in acre-feet)

Jul	Aug	Sep	Oct	Nov	Dec	Total	Description
							<b>SAN LUIS FIELD DIVISION (Cont.)</b>
271,050	218,324	66,435	54,541	33,561	72,361	1,143,831	California Aqueduct (Pools 14 thru 21)
290,048	351,262	191,476	122,619	56,817	88,491	1,472,471	Inflow, Dos Amigos P.P.(State)
225,875	166,967	69,105	50,604	34,694	70,462	1,023,741	Inflow, Dos Amigos P.P.(Fed. and Other)
515,923	518,229	260,581	173,223	91,511	158,953	2,496,212	Total Inflow, Dos Amigos P.P.
25	0	0	0	0	0	25,159	Flow into Aqueduct
0	3	0	1	0	0	4	Delivered to Dept. of Fish and Game (State)
0	2	1	0	1	0	4	Delivered to Dept. of Fish and Game (Fed.)
0	0	25	12	9	0	71	Miscellaneous Outflow (Phase 1)
53,023	48,000	0	13,423	277	0	136,519	Delivered to Fed. Customers (State Transfers)
218,027	170,324	66,410	41,106	33,275	72,361	1,007,241	Delivered to Fed. Customers
248,566	309,700	192,309	131,966	60,663	91,410	1,376,296	Outflow, Check 21 (State)
0	1,673	3,077	3,831	3,551	848	14,081	Outflow, Check 21 (Fed.)
477	-284	-334	149	-1,334	438	-469	Change in Storage
4,145	11,189	907	17,265	4,931	6,104	12,376	Computed Losses (-), Gains (+)
							<b>SAN JOAQUIN FIELD DIVISION</b>
							California Aqueduct, Check 21 to Buena Vista Pumping Plant
248,566	309,700	192,309	131,966	60,663	91,410	1,376,296	Inflow, Check 21 (State)
0	1,673	3,077	3,831	3,551	848	14,081	Inflow, Check 21 (Fed.)
248,566	311,373	195,386	135,797	64,214	92,258	1,390,377	Total Inflow, Check 21
12,803	0	0	0	0	0	182,986	Kern River Intertie
117,062	147,048	90,650	53,619	27,111	67,602	693,198	Delivered to Contracting State Agencies
0	1,673	3,077	3,831	3,551	848	14,081	Delivered to Fed. Customers
0	0	0	0	0	0	10,398	Friant CVP Inflow
110,770	128,235	83,690	66,230	27,586	16,553	711,593	Outflow, Buena Vista P.P.
23,200	21,913	12,966	7,702	3,237	3,780	117,815	Coastal Br. Diversion
383	102	-46	335	-199	387	560	Change in Storage
-9,954	-12,402	-5,049	-4,080	-2,928	-3,088	-46,515	Computed Losses (-), Gains (+)
							California Aqueduct, Buena Vista P.P. to Teerink Pumping Plant
110,770	128,235	83,690	66,230	27,586	16,553	711,593	Inflow, Buena Vista P.P.
24,028	24,621	11,211	5,255	2,321	3,278	103,454	Delivered to Contracting State Agencies
0	0	0	0	0	0	0	W.R.M.W.S.D. Pumpback
89,103	106,483	75,581	62,055	26,064	14,045	627,365	Outflow, Teerink Pumping Plant
199	16	-38	39	-40	-297	-267	Change in Storage
2,560	2,885	3,064	1,119	759	473	18,959	Computed Losses (-), Gains (+)
							California Aqueduct, Teerink Pumping Plant to Chrisman Pumping Plant
89,103	106,483	75,581	62,055	26,064	14,045	627,365	Inflow, Teerink Pumping Plant
7,637	5,783	2,547	2,210	703	624	29,839	Delivered to Contracting State Agencies
80,393	99,133	71,453	58,358	24,457	12,461	583,912	Outflow, Chrisman Pumping Plant
-22	-11	-3	71	-87	10	8	Change in Storage
-1,095	-1,578	-1,584	-1,416	-991	-950	-13,606	Computed Losses (-), Gains (+)
							California Aqueduct, Chrisman Pumping Plant to Edmonston Pumping Plant
80,393	99,133	71,453	58,358	24,457	12,461	583,912	Inflow, Chrisman Pumping Plant
4,736	3,754	2,296	1,622	333	266	20,869	Delivered to Contracting State Agencies
74,998	94,951	68,982	57,127	24,766	13,096	564,121	Outflow, Edmonston Pumping Plant
-29	9	27	25	52	-40	-6	Change in Storage
-688	-419	-148	416	694	861	1,072	Computed Losses (-), Gains (+)
							Coastal Branch, California Aqueduct
23,200	21,913	12,966	7,702	3,237	3,780	117,815	Inflow, Las Perillas P.P.
0	0	0	0	0	0	0	B.M.W.S.D. Pumpback
21,167	19,970	12,455	7,797	3,281	3,756	109,400	Delivered to Contracting State Agencies
0	0	0	0	0	0	0	Delivered to Fed. Customers
-20	12	-24	23	-55	36	-15	Change in Storage
-2,053	-1,931	-535	118	-11	12	-8,430	Computed Losses (-), Gains (+)

**Table 22c. Summary of California Aqueduct Operation**

**1998**  
(in acre-feet)

Description	Jan	Feb	Mar	Apr	May	Jun
<b>SOUTHERN FIELD DIVISION</b>						
California Aqueduct, Edmonston Pumping Plant to Junction of West Branch						
Inflow, Edmonston Pumping Plant	38,149	8,050	13,471	57,728	52,814	59,989
Outflow, West Branch	18,883	8,071	7	104	112	4,413
Outflow, East Branch	19,231	0	13,462	57,591	52,665	55,542
Change in Storage	5	-1	-3	-4	7	-1
Computed Losses (-), Gains (+)	-30	20	-5	-37	-30	-35
California Aqueduct, Junction of West Branch to Pearblossom P.P.						
Inflow (Aqueduct)	19,231	0	13,462	57,591	52,665	55,542
Inflow (L.A.D.W.P.)	0	0	0	0	0	0
Delivered to Contracting Agencies	2,586	1,067	1,714	2,860	5,232	8,217
Outflow, Pearblossom P.P.	13,968	461	11,300	52,629	44,722	44,342
Change in Storage	490	-780	67	-664	491	403
Computed Losses (-), Gains (+)	-2,187	748	-381	-2,766	-2,220	-2,580
California Aqueduct, Pearblossom P.P. to Silverwood Lake						
Inflow, Pearblossom P.P.	13,968	461	11,300	52,629	44,722	44,342
Deliveries (Exchange of Natural Inflow)	672	212	16	0	287	277
Exchange of Natural Inflow (Los Flores T.O.)	799	236	119	1,354	1,351	1,322
Outflow to Silverwood Lake	13,164	367	10,884	53,434	45,177	43,690
Change in Storage	-374	-163	14	12	207	-45
Computed Losses (-), Gains (+)	293	191	-267	2,171	2,300	902
Silverwood Lake Operation						
Inflow, Project	13,164	367	10,884	53,434	45,177	43,690
Inflow, Natural	827	13,948	6,560	6,781	9,177	2,860
Delivered to Contracting Agencies	80	55	17	30	35	41
Recreation Deliveries	1	1	1	1	4	7
Outflow, Natural Inflow Released	87	7,208	5,134	5,240	7,754	1,733
Outflow, Project Water at San Bernardino Tunnel	12,928	8,651	18,035	50,825	42,833	42,390
Change in storage	1,090	-359	-5,660	3,480	2,462	2,175
Computed Losses (-), Gains (+)	195	1,241	83	-639	-1,266	-204
California Aqueduct, Silverwood Lake to Lake Perris						
Inflow, SBMWD Reverse Flow	0	0	0	0	0	0
Inflow, San Bernardino Tunnel	12,928	8,651	18,035	50,825	42,833	42,390
Inflow, MWD Pumpback	0	0	0	0	0	0
Delivered to Contracting Agencies	11,964	7,842	11,571	20,832	32,156	28,348
Outflow to Lake Perris	783	848	6,486	29,982	10,683	14,033
Change in Storage	170	-49	-33	0	-16	-2
Operational Losses (-), Gains (+)	-11	-10	-11	-11	-10	-11
Lake Perris Operation						
Inflow	783	848	6,486	29,982	10,683	14,033
Delivered to Contracting Agencies	287	284	5,213	18,423	7,822	13,075
Recreation Deliveries	6	3	4	12	15	41
Outflow (Pumpback)	0	0	0	0	0	0
Change in Storage	582	2,146	740	11,520	2,543	46
Computed Losses (-), Gains (+)	92	1,585	-529	-27	-303	-871

**Table 22c. Summary of California Aqueduct Operations**

**1998**  
(in acre-feet)

Jul	Aug	Sep	Oct	Nov	Dec	Total	Description
							<b>SOUTHERN FIELD DIVISION</b>
							California Aqueduct, Edmonston Pumping Plant to Junction of West Branch
74,998	94,951	68,982	57,127	24,766	13,096	564,121	Inflow, Edmonston Pumping Plant
20,634	26,781	19,310	18,005	7,731	211	124,262	Outflow, West Branch
54,330	68,122	49,634	39,096	17,009	12,883	439,565	Outflow, East Branch
-9	9	4	-12	6	-20	-19	Change in Storage
-43	-39	-34	-38	-20	-22	-313	Computed Losses (-), Gains (+)
							California Aqueduct, Junction of West Branch to Pearblossom P.P.
54,330	68,122	49,634	39,096	17,009	12,883	439,565	Inflow (Aqueduct)
0	0	0	0	0	0	0	Inflow (L.A.D.W.P.)
11,008	11,590	7,658	5,580	3,126	2,782	63,420	Delivered to Contracting Agencies
40,378	53,294	39,592	30,281	12,746	8,889	352,602	Outflow, Pearblossom P.P.
-210	373	-126	398	-380	-425	-363	Change in Storage
-3,154	-2,865	-2,510	-2,837	-1,517	-1,637	-23,906	Computed Losses (-), Gains (+)
							California Aqueduct, Pearblossom P.P. to Silverwood Lake
40,378	53,294	39,592	30,281	12,746	8,889	352,602	Inflow, Pearblossom P.P.
195	147	242	256	1,968	308	4,580	Deliveries (Exchange of Natural Inflow)
1,396	452	997	438	161	419	9,044	Exchange of Natural Inflow (Los Flores T.O.)
40,231	54,833	40,611	30,754	10,789	8,627	352,561	Outflow to Silverwood Lake
192	171	-409	34	53	-96	-404	Change in Storage
1,636	2,309	1,849	1,201	225	369	13,179	Computed Losses (-), Gains (+)
							<b>Silverwood Lake Operation</b>
40,231	54,833	40,611	30,754	10,789	8,627	352,561	Inflow, Project
839	172	80	74	148	219	41,685	Inflow, Natural
103	100	84	58	41	60	704	Delivered to Contracting Agencies
12	11	6	6	2	1	53	Recreation Deliveries
151	11	11	12	11	12	27,364	Outflow, Natural Inflow Released
46,081	50,738	37,528	28,740	10,785	7,317	356,851	Outflow, Project Water at San Bernardino Tunnel
-6,299	3,261	1,885	1,307	115	1,021	4,478	Change in storage
-1,022	-884	-1,177	-705	17	-435	-4,796	Computed Losses (-), Gains (+)
							California Aqueduct, Silverwood Lake to Lake Perris
0	0	0	0	0	0	0	Inflow, SBMWD Reverse Flow
46,081	50,738	37,528	28,740	10,785	7,317	356,851	Inflow, San Bernardino Tunnel
0	0	0	0	0	0	0	Inflow, MWD Pumpback
38,880	48,342	35,841	26,693	8,832	6,133	277,434	Delivered to Contracting Agencies
7,290	2,214	1,733	2,204	1,769	1,274	79,299	Outflow to Lake Perris
-100	171	-56	-166	174	-101	-8	Change in Storage
-11	-11	-10	-9	-10	-11	-126	Operational Losses (-), Gains (+)
							<b>Lake Perris Operation</b>
7,290	2,214	1,733	2,204	1,769	1,274	79,299	Inflow
6,262	1,657	312	1,785	315	329	55,764	Delivered to Contracting Agencies
61	54	46	29	16	23	310	Recreation Deliveries
0	0	0	0	0	0	0	Outflow (Pumpback)
-115	-728	0	-659	795	-227	16,643	Change in Storage
-1,082	-1,231	-1,375	-1,049	-643	-1,149	-6,582	Computed Losses (-), Gains (+)

**Table 22d. Summary of California Aqueduct Operation**

**1998**  
(in acre-feet)

Description	Jan	Feb	Mar	Apr	May	Jun
<b>SOUTHERN FIELD DIVISION (Cont.)</b>						
West Branch California Aqueduct Tehachapi Afterbay to Oso P.P.						
Inflow	18,883	8,071	7	104	112	4,413
Outflow, Oso Pumping Plant	18,787	8,107	0	0	0	4,308
Change in Storage	5	-5	-9	-10	20	-2
Computed Losses (-), Gains (+)	-91	31	-16	-114	-92	-107
West Branch California Aqueduct Oso P.P. to Pyramid Lake						
Inflow, Oso P.P.	18,787	8,107	0	0	0	4,308
Deliveries	0	0	0	0	0	0
Outflow Through Warne to Pyramid Lake	19,107	7,447	0	0	0	4,088
Change in Storage	-361	917	-41	-45	-74	9
Operational Losses (-), Gains (+)	-41	257	-41	-45	-74	-211
<b>Pyramid Lake Operation</b>						
Inflow, Project	19,107	7,447	0	0	0	4,088
Inflow, Natural	2,577	66,110	16,723	14,558	16,102	6,493
Inflow, Pumpback from Elderberry Forebay	52,864	35,879	50,544	69,796	93,949	112,755
Deliveries (Fish Enhancement)	0	0	0	0	0	0
Deliveries	0	0	0	0	0	0
Delivered to Dept. of Parks and Rec. (State)	0	0	0	0	0	0
Outflow, Pyramid Diversion	549	43,287	9,086	2,539	1,530	1,474
Outflow, Angeles Tunnel	74,323	63,542	65,446	88,155	97,518	128,189
Change in Storage	64	1,295	-5,266	-7,269	11,752	-8,727
Computed Losses (-), Gains (+)	388	-1,312	1,999	-929	749	-2,400
<b>Elderberry Forebay Operation</b>						
Inflow, Project through Castaic P-G Plant	74,323	63,542	65,446	88,155	97,518	128,189
Inflow, Natural	478	24,738	5,274	5,160	7,686	2,582
Outflow, Pumpback to Pyramid Lake	52,864	35,879	50,544	69,796	93,949	112,755
Outflow, Project Water Released to Castaic Lake	18,630	47,269	15,002	22,053	15,838	11,643
Change in Storage	2,695	3,352	4,488	1,711	-8,311	6,108
Computed Losses (-), Gains (+)	-612	-1,780	-686	245	-3,728	-265
<b>Castaic Lake Operation</b>						
Inflow, Project	18,630	47,269	15,002	22,053	15,838	11,643
Inflow, Natural	353	18,914	6,360	6,185	10,771	3,100
Delivered to Contracting Agencies	18,086	13,758	8,757	21,845	15,609	17,945
Deliveries to Recreation (State)	15	4	0	0	15	6
Outflow, Castaic Lagoon	1,372	19,778	10,778	4,596	7,748	186
Change in Storage	-396	32,223	887	-443	1,554	-3,657
Computed Losses (-), Gains (+)	94	-420	-940	-2,240	-1,683	-263
<b>Castaic Lagoon Operation</b>						
Inflow (Recreation Deliveries)	0	0	0	0	0	0
Inflow	1,372	19,778	10,778	4,596	7,748	186
Inflow, Non-project	0	0	0	0	0	0
Outflow	1,248	19,573	10,778	4,596	7,592	47
Deliveries to Recreation (State)	34	24	50	55	115	91
Change in Storage	90	181	-137	-95	41	48
Computed Losses (-), Gains (+)	0	0	-87	-40	0	0

**Table 22d. Summary of California Aqueduct Operations**

**1998**  
(in acre-feet)

Jul	Aug	Sep	Oct	Nov	Dec	Total	Description
							SOUTHERN FIELD DIVISION (Cont.)
							West Branch California Aqueduct Tehachapi Afterbay to Oso P.P.
20,634	26,781	19,310	18,005	7,731	211	124,262	Inflow
20,531	26,635	19,194	17,922	7,647	204	123,335	Outflow, Oso Pumping Plant
-27	27	12	-34	21	-61	-63	Change in Storage
-130	-119	-104	-117	-63	-68	-990	Computed Losses (-), Gains (+)
							West Branch California Aqueduct Oso P.P. to Pyramid Lake
20,531	26,635	19,194	17,922	7,647	204	123,335	Inflow, Oso P.P.
0	0	0	5	2	0	7	Deliveries
20,978	26,984	18,798	19,026	7,817	23	124,268	Outflow Through Warne to Pyramid Lake
-382	-349	535	-475	-167	-93	-526	Change in Storage
65	0	139	634	5	-274	414	Operational Losses (-), Gains (+)
							Pyramid Lake Operation
20,978	26,984	18,798	19,026	7,817	23	124,268	Inflow, Project
2,742	1,422	1,445	1,453	1,639	1,871	133,135	Inflow, Natural
139,908	119,661	93,084	107,379	86,147	77,207	1,039,173	Inflow, Pumpback from Elderberry Forebay
0	0	0	0	0	0	0	Deliveries (Fish Enhancement)
0	0	0	0	0	0	0	Deliveries
0	0	0	0	0	0	0	Delivered to Dept. of Parks and Rec. (State)
1,548	1,567	1,749	4,649	5,365	2,808	76,151	Outflow, Pyramid Diversion
159,089	142,906	110,892	123,982	89,965	82,236	1,226,243	Outflow, Angeles Tunnel
-272	1,849	-87	1,974	1,435	-4,886	-8,138	Change in Storage
-3,263	-1,745	-773	2,747	1,162	1,057	-2,320	Computed Losses (-), Gains (+)
							Elderberry Forebay Operation
159,089	142,906	110,892	123,982	89,965	82,236	1,226,243	Inflow, Project through Castaic P-G Plant
856	271	245	213	299	432	48,234	Inflow, Natural
139,908	119,661	93,084	107,379	86,147	77,207	1,039,173	Outflow, Pumpback to Pyramid Lake
23,649	22,936	19,863	15,124	2,424	0	214,431	Outflow, Project Water Released to Castaic Lake
-3,131	1,554	-3,066	-1,291	-616	3,499	6,992	Change in Storage
481	974	-1,256	-2,983	-2,309	-1,962	-13,881	Computed Losses (-), Gains (+)
							Castaic Lake Operation
23,649	22,936	19,863	15,124	2,424	0	214,431	Inflow, Project
1,301	389	358	337	400	527	48,995	Inflow, Natural
26,559	28,661	17,690	25,136	13,706	11,278	219,030	Delivered to Contracting Agencies
31	57	34	30	20	0	212	Deliveries to Recreation (State)
1,646	764	634	504	947	1,072	50,025	Outflow, Castaic Lagoon
-3,545	-7,387	-540	-9,955	-12,476	-12,642	-16,377	Change in Storage
-259	-1,230	-2,403	254	-627	-819	-10,536	Computed Losses (-), Gains (+)
							Castaic Lagoon Operation
0	0	0	0	0	0	0	Inflow (Recreation Deliveries)
1,646	764	634	504	947	1,072	50,025	Inflow
0	0	0	0	0	0	0	Inflow, Non-project
1,525	591	619	426	772	1,050	48,817	Outflow
143	177	102	103	69	47	1,010	Deliveries to Recreation (State)
-22	-4	-87	-25	106	-25	71	Change in Storage
0	0	0	0	0	0	-127	Computed Losses (-), Gains (+)

## Glossary

**accretion** - the water accumulated and retained within a service area.

**acre-foot (AF)** - a quantity or volume of water covering one acre to a depth of one foot; equal to 43,560 cubic feet or 325,851 gallons.

**active storage capacity** - the total usable reservoir capacity available for seasonal or cyclic water storage. It is gross reservoir capacity minus inactive storage capacity.

**afterbay** - a reservoir that regulates fluctuating discharges from a hydroelectric power plant or a pumping plant.

**alluvium** - a stratified bed of sand, gravel, silt, and clay deposited by flowing water.

**aquifer** - a geologic formation that stores and transmits water and yields significant quantities of water to wells and springs.

**average annual runoff** - the average value of annual runoff amounts for a specified area calculated for a selected period of record that represents average hydrologic conditions.

**balanced water conditions** - exist when upstream reservoir storage releases, plus other inflows, approximately equal the water supply needed to (1) satisfy Sacramento Valley and Sacramento-San Joaquin Delta in-basin needs, including Delta water quality requirements, and (2) meet export needs.

**benthic invertebrates** - aquatic animals without backbones that dwell on or in the bottom sediments of fresh or salt water. Examples: clams, crayfish, and a wide variety of worms.

**biota** - all living organisms of a region, as in a stream or other body of water.

**brackish water** - water containing dissolved minerals in amounts that exceed normally acceptable standards for municipal, domestic, and irrigation uses. Considerably less saline than sea water.

**carriage water** - the amount of water needed above an increased export so as to not increase salinity in the Delta.

**conjunctive use** - the operation of a ground water basin in combination with a surface water storage and conveyance system. Water is stored in the ground water basin for later use by intentionally recharging the basin during years of above-average water supply.

**Decision 1485 operating criteria** - standards for operating water project facilities under Water Rights Decision 1485 regarding the Sacramento-San Joaquin Delta and Suisun Marsh, adopted by the State Water Resources Control Board, August 1978.

**Delta consumptive use** - the sum of evapotranspiration and changes in soil moisture of Delta lands and evaporation from Delta channels.

**Delta outflow index** - a calculated approximation of this seaward freshwater outflow as it passes Chipps Island near Pittsburg, beyond the confluence of the Sacramento and San Joaquin Rivers.

**depletion** - the water consumed within a service area and no longer available as a source of supply.

**dissolved organic compounds** - carbon substances dissolved in water.



**drainage basin** - the area of land from which water drains into a river; for example, the Sacramento River Basin, in which all land area drains into the Sacramento River. Also called, "catchment area," "watershed," or "river basin."

**drought condition** - hydrologic conditions during a defined drought period during which rainfall and runoff are much less than average.

**ecology** - the study of the interrelationships of living organisms to one another and to their surroundings.

**ecosystem** - recognizable, relatively homogeneous units, including the organisms they contain, their environment, and all the interactions among them.

**effluent** - waste water or other liquid, partially or completely treated or in its natural state, flowing from a treatment plant.

**environment** - the sum of all external influences and conditions affecting the life and development of an organism or ecological community; the total social and cultural conditions.

**estuary** - the lower course of a river entering the sea influenced by tidal action where the tide meets the river current.

**evapotranspiration (ET)** - the quantity of water transpired (given off), retained in plant tissues, and evaporated from plant tissues and surrounding soil surfaces. Quantitatively, it is usually expressed in terms of depth of water per unit area during a specified period of time.

**evapotranspiration of applied water (ETAW)** - the portion of the total evapotranspiration which is provided by irrigation.

**forebay** - a reservoir or pond situated at the intake of a pumping plant or power plant to stabilize water levels; also a storage basin for regulating water for percolation into ground water basins.

**fry** - a recently hatched fish.

**gross reservoir capacity** - the total storage capacity available in a reservoir for all purposes, from the streambed to the normal maximum operating level. Includes dead (or inactive) storage, but excludes surcharge (water temporarily stored above the elevation of the top of the spillway).

**ground water** - water that occurs beneath the land surface and completely fills all pore spaces of the alluvium, soil or rock formation in which it is situated.

**ground water basin** - a ground water reservoir, defined by an overlying land surface and the underlying aquifers that contain water stored in the reservoir.

**ground water overdraft** - the condition of a ground water basin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years during which water supply conditions approximate average.

**ground water recharge** - increases in ground water storage by natural conditions or by human activity.

**ground water table** - the upper surface of the zone of saturation, except where the surface is formed by an impermeable body.

**hydraulic barrier** - a barrier developed in the estuary by release of fresh water from upstream reservoirs to prevent intrusion of sea water into the body of fresh water.

**hydrologic balance** - an accounting of all water inflow to, water outflow from, and changes in water storage within a hydrologic unit over a specified period of time.

**hydrologic basin** - the complete drainage area upstream from a given point on a stream.

**hydrologic region** - a study area, consisting of one or more planning subareas.

**joint-use facilities** - specific pumping plants, power plants, canals, and reservoirs in which both State and federal agencies participated in the construction, use, and maintenance.

**land subsidence** - the lowering of the natural land surface in response to earth movements; lowering of fluid pressure (or lowering of ground water level); removal of underlying supporting materials by mining or solution of solids, either artificially or from natural causes; compaction caused by wetting (hydrocompaction); oxidation of organic matter in soils; or added load on the land surface.

**megawatt** - one million watts.

**milligrams per liter (mg/L)** - the weight in milligrams of any substance dissolved in one liter of liquid; nearly the same as parts per million.

**natural flow** - the flow past a specified point on a natural stream that is unaffected by stream diversion, storage, import, export, return flow, or change in use caused by modification in land use.

**percolation** - the downward movement of water throughout the soil or alluvium to a ground water table.

**permeability** - the capability of soil or other geologic formations to transmit water.

**phytoplankton** - minute plants, usually algae, that live suspended in bodies of water and that drift about because they cannot move by themselves or because they are too small or too weak to swim effectively against a current.

**pollution (of water)** - the alteration of the physical, chemical, or biological properties of water by the introduction of any substance into water that adversely affects any beneficial use of water.

**prior water right** - a water designation used for water delivered based on its use prior to SWP construction.

**pumping-generating plant** - a plant at which the turbine-driven generators can also be used as motor-driven pumps.

**recharge basin** - a surface facility, often a large pond, used to increase the percolation of surface water into a ground water basin.

**riparian vegetation** - vegetation growing on the banks of a stream or other body of water.

**runoff** - the total volume of surface flow from an area during a specified time.

**Sacramento River index** - the sum of the Sacramento Valley's unimpaired runoff at the following four locations: Sacramento River near Red Bluff; total Feather River inflow to Lake Oroville; Yuba River at Smartville; and total American River inflow to Folsom Lake.

**salinity** - generally, the concentration of mineral salts dissolved in water. Salinity may be measured by weight (total dissolved solids), electrical conductivity, or osmotic pressure. See **total dissolved solids**.

**salinity intrusion** - the movement of salt water into a body of fresh water. It can occur in either surface water or ground water bodies.

**salt-water barrier** - a physical facility or method of operation designed to prevent the intrusion of salt water into a body of fresh water.

**sediment** - soil or mineral material transported by water and deposited in streams or other bodies of water.

**seepage** - the gradual movement of a fluid into, through, or from a porous medium.

**service area** - the geographical land area served by a distribution system of a water agency.

**snow water content** - a calculated or measured amount of water contained in packed snow based on its depth and density.

**spawning** - the depositing and fertilizing of eggs (roe) by fish and other aquatic life.

**streamflow** - the rate of water flow past a specified point in a channel.

**surplus water** - developed water supplies in excess of contract entitlement or apportioned water.

**total dissolved solids (TDS)** - a quantitative measure of the residual minerals dissolved in water that remain after evaporation of a solution. Usually expressed in milligrams per liter. See **salinity**.

**transpiration** - an essential physiological process in which plant tissues give off water vapor to the atmosphere.

**unimpaired runoff** - represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds.

**waste water** - the water, liquid waste, or drainage from a community, industry, or institution.

**water conservation** - reduction in applied water due to more efficient water use.

**water quality** - used to describe the chemical, physical, and biological characteristics of water, usually in regard to its suitability for a particular purpose or use.

**water right** - a legally protected right to take possession of water occurring in a natural waterway and to divert that water for beneficial use.

**water table** - see **ground water table**.

**water year** - a continuous 12-month period for which hydrologic records are compiled and summarized. In California, it begins on October 1 and ends September 30 of the following year.

**watershed** - see **drainage basin**.